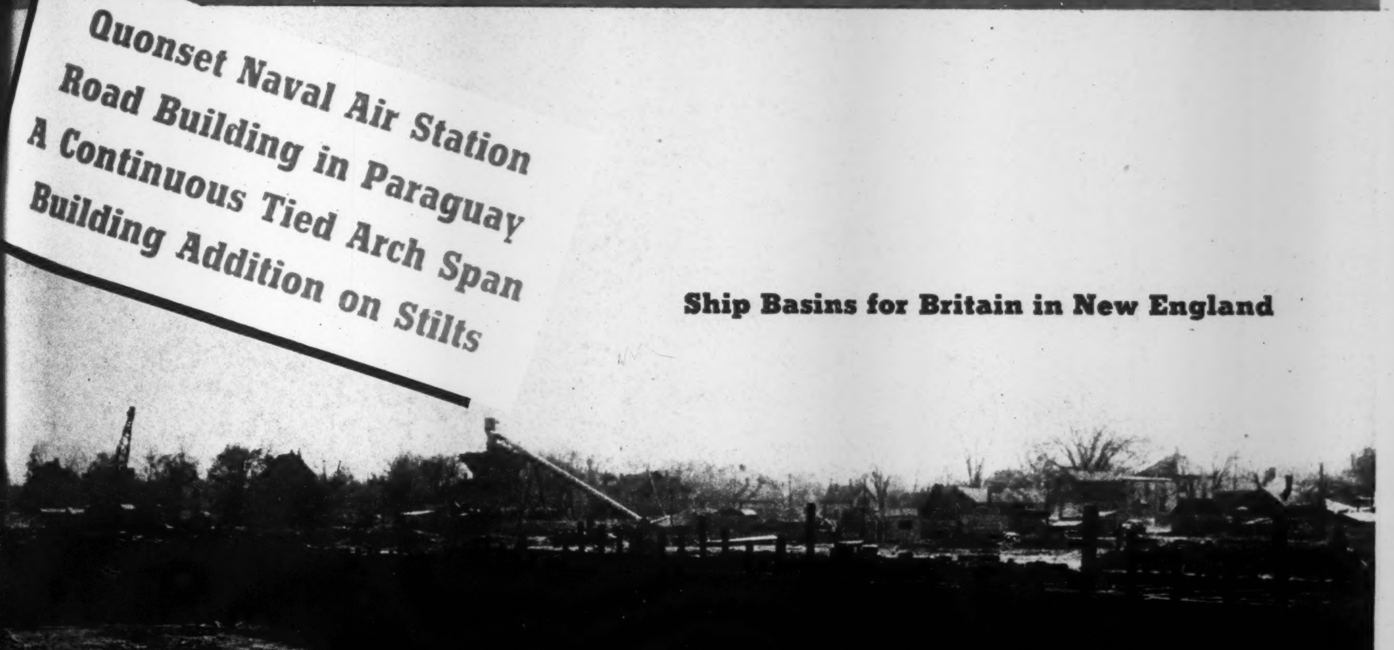
ENGINEERING NEWS-RECORD

JUNE 5, 1941

JUN 9 1941

Quonset Naval Air Station
Road Building in Paraguay
A Continuous Tied Arch Span
Building Addition on Stilts



Ship Basins for Britain in New England

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Two words, SPEED and DURABILITY, held the answer to this tough sewer problem. Speed was essential because the collapsed sewer was endangering private property. Engineers met both requirements by using Asbestos-Bonded ARMCO Corrugated Pipe to make a permanent replacement in only 18 hours. The expense and trouble of resorting to temporary emergency measures was averted.

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Quick replacement of this failed sewer was needed to prevent further property damage. Yet economy dictated that corrective measures be of a permanent nature. Asbestos-Bonded ARMCO Pipe was the practical answer.

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ARMCO ASBESTOS-BONDED **SEWER PIPE**

ENGINEERING NEWS-RECORD

Devoted to Buildings, Sewers, Waterworks, Bridges, Highways, Streets, Dams, Foundations, Earthwork, Flood Control, Public Works, Irrigation, Canals, Railroads

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Vol. 126 JUNE 5, 1941 No. 23

THIS WEEK

• Piling eight stories on top of a six-story structure whose foundations were originally designed for four stories presented an interesting structural problem. How the eight-story addition was supported on six-story stilts is described in this issue.

• With increasing rapidity the construction industry is having to deal with the system of federal control over material and equipment, set up to assure first things first for defense. A contractor or owner having difficulty getting necessary materials or equipment has several courses open to him. The article, "What Priorities Mean to Construction," tells what these courses are.

• The continuous tied arch bridge over the Meramec River near St. Louis, with a main span of 264 ft. and side spans of 192 ft., is believed to be the first of its type in the U. S., although structures of this general type, but using plate rib rather than framed construction, have been built in Europe. How stress analysis was accomplished by the general method of least work, coupled with the determination of influence lines by the method of elastic weights instead of by solving simultaneous equations, is covered in this issue.

ANNUAL WATERWORKS NUMBER

• Tuning up waterworks to meet the new demands from industrial expansion, from new housing, from population shifts for defense work and military training is the theme of *Engineering News-Record's* Annual Waterworks Number. Besides ten feature articles on preparing water systems for highest efficiency, this number will carry a directory of waterworks manufacturers and products, as well as a special section on new waterworks equipment.

June 19, 1941

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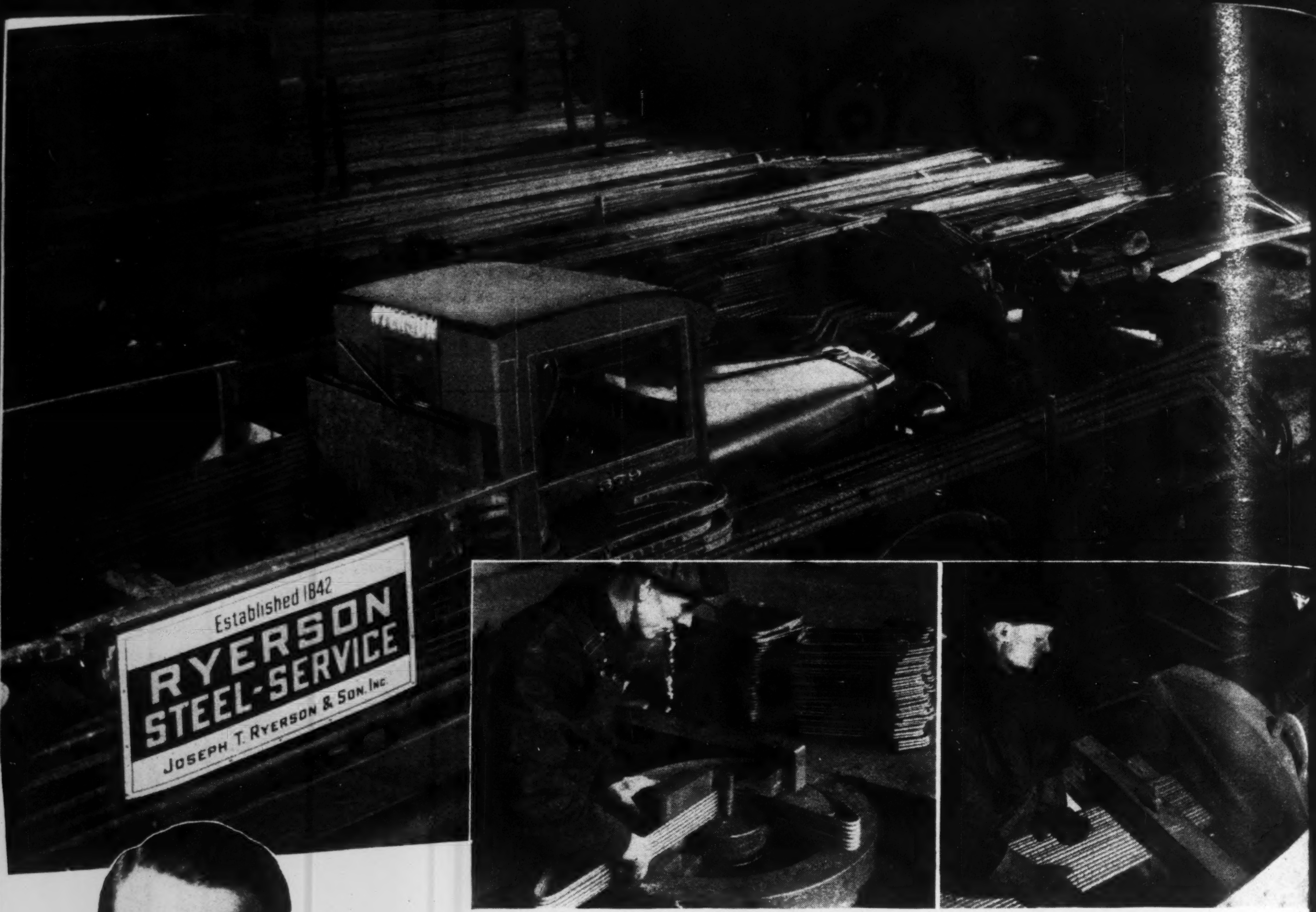

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MONTHLY CONSTRUCTION BUSINESS SUMMARY

ENR CONSTRUCTION VOLUME AND NEW CAPITAL . . . . F H A MORTGAGES

	May			Five Months		
(,000 omitted)	1940 (5 wk.)	1941 (5 wk.)	% Change	1940 (22 wk.)	1941 (22 wk.)	% Change
Total Construction	$282,296	$409,371	+45.0	$1,136,853	$2,252,182	+98.0
Private Construction	92,649	125,280	+35.0	392,200	637.159	+63.0
Public Construction	189,647	284,091	+50.0	744,653	1,615,023	+117.0
Federal	73,520	162,770	+221.0	165,597	1,068,520	+546.0
Total New Productive Capital	$216,013	$223,996	+4.0	$581,403	$3,271,780	+463.0
Private Investment	206,012	39,291	−81.0	497,249	328,547	−34.0
Federal (non-federal work)	10,091	12,205	+21.0	84,154	51,896	−38.0
Federal (federal work)	....	172,500	....	....	2,891,337	....
FHA Mortgages Selected for Appraisal	$129,185	$145,607*	+13.0	$526,763	$620,420*	+18.0

*Preliminary.

CONSTRUCTION COSTS . . . . WAGE RATES . . . . PRICES

	June		%	Change May to June					
				1940			1941		
	1940	1941	Change	May	June	%	May	June	%
ENR Construction Cost Index, 1913 = 100	241.59	256.79	+6.3	238.86	241.59	+1.1	255.55	256.79	+0.5
ENR Building Cost Index, 1913 = 100	201.65	209.41	+3.9	201.17	201.65	+0.2	209.24	209.41	+0.1

ENR 20-CITIES' AVERAGE

	1940	1941	% Change	May 1940	June 1940	%	May 1941	June 1941	%
Common Labor	$0.703	$0.747	+6.3	$0.690	$0.703	+1.9	$0.741	$0.747	+0.8
Skilled Labor (Av. 3 trades)	1.472	1.492	+1.4	1.467	1.472	+0.3	1.490	1.492	+0.1
Bricklayers	1.568	1.581	+0.8	1.563	1.568	+0.3	1.569	1.581	+0.8
Structural Ironworkers	1.520	1.569	+3.2	1.519	1.520	+0.1	1.569	1.569	0
Carpenters	1.328	1.327	−0.1	1.319	1.328	+0.7	1.332	1.327	−0.4
Cement, per bbl	$2.51	$2.52	+0.4	$2.58	$2.51	−2.7	$2.52	$2.52	0
Reinforcing steel per cwt.	2.45	2.58	+5.3	2.47	2.45	−0.8	2.57	2.58	+0.4
Struct. shapes, base	2.10	2.10	0	2.10	2.10	0	2.10	2.10	0
Sand, per ton	1.18	1.17	−0.8	1.18	1.18	0	1.18	1.17	−0.8
Lumber, 2x4 Fir, per M ft.	34.88	41.18	+18.1	34.80	34.88	+0.2	40.68	41.18	+1.2
Lumber, 2x4 Pine, per M ft.	31.59	37.07	+17.3	31.44	31.59	+0.5	37.49	37.07	−1.1
Brick, common, per M	14.32	14.68	+2.5	14.34	14.32	−0.1	14.55	14.68	+0.9
Ready-mixed concrete, cy.	6.98	6.93	−0.7	7.01	6.98	−0.4	6.93	6.93	0
Struct. clay tile. 3x12x12	74.49	74.59	+0.1	74.49	74.49	0	74.49	74.59	+0.1
Paving asphalt, cars, ton	14.19	14.43	+1.7	14.22	14.19	−0.2	14.40	14.43	+0.2

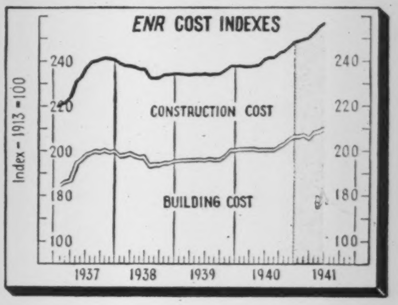
MATERIAL SHIPMENTS . . . . BUILDING PERMITS

	May 1940	May 1941	% Change	Apr. 1941	% Change Apr.-May
Lumber (% 1935–39 wk. seas. av.) N.L.M.A	115.4	126.3	+9.2	120.8	+4.5
Steel (% operating capacity) A.I.S.I	71.4	98.6	+38.1	97.0	+1.7

	April 1940	April 1941	% Change	Four Months 1940	Four Months 1941	% Change
Fabricated Structural Steel, tons, A.I.S.C.	116,317	176,594	+52.0	420,308	672,699	+60.0
Cement. thous. bbl., U.S.B. of M	10,829	14,132	+30.5	27,345	39,487	+44.5
Building Permits, Dun & Bradstreet, (,000 omitted)	$122,584	$141,744	+15.6	$408,338	$478,857	+17.3

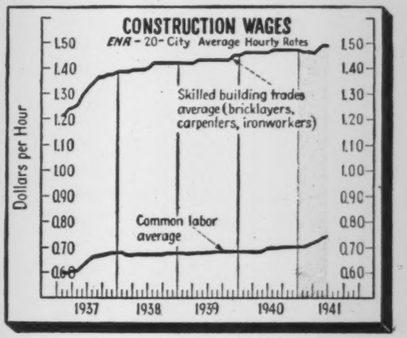
RENT INDEX . . . . EMPLOYMENT

	April 1940	April 1941	% Change	Mar. 1941	% Change Mar.-Apr.
Rent (Housing) Index, N.I.C.B	86.7	87.8	+1.3	87.7	+0.1
Est. Total Employment, thous., N.I.C.B	46,005	50,150	+9.1	49,398	+1.7
Est. Construction Employment, thous., N.I.C.B	1,940	2,576	+32.7	2,560	+0.6



ENR INDEX NUMBERS

Base = 100	Construction Cost 1913	Construction Cost 1926	Building Cost '13	Building Cost '26	Volume '13	Volume '26
June, 1941	256.79	123.44	209.41	113.20	...	...
May, 1941	255.55	122.84	209.24	113.11	275	121
Apr., 1941	252.40	121.33	208.60	112.76	322	141
Mar., 1941	250.71	120.52	207.88	112.37	386	169
Feb., 1941	250.50	120.42	208.42	112.67	374	164
Jan., 1941	249.69	120.03	207.94	112.46	402	176
Dec., 1940	249.12	119.75	208.19	112.54	344	151
Nov., 1940	247.24	118.85	206.24	111.49	331	145
Oct., 1940	245.02	117.78	204.02	110.29	490	215
Sept., 1940	244.13	117.35	203.13	109.83	324	142
Aug., 1940	242.18	116.42	201.71	109.04	281	123
July, 1940	242.15	116.40	201.68	109.02	308	135
June, 1940	241.59	116.13	201.65	109.00	225	99
May, 1940	238.86	114.82	201.17	108.75	201	88
1940 (Av.)	241.96	116.31	202.81	109.64	269	118
1939 (Av.)	235.51	113.21	197.44	106.73	211	92
1938 (Av.)	235.86	113.34	196.83	106.40	197	86
1937 (Av.)	234.71	112.66	196.15	106.07	172	75



ENGINEERING CONSTRUCTION CONTRACTS——ENGINEERING NEWS-RECORD——MAY, 1941

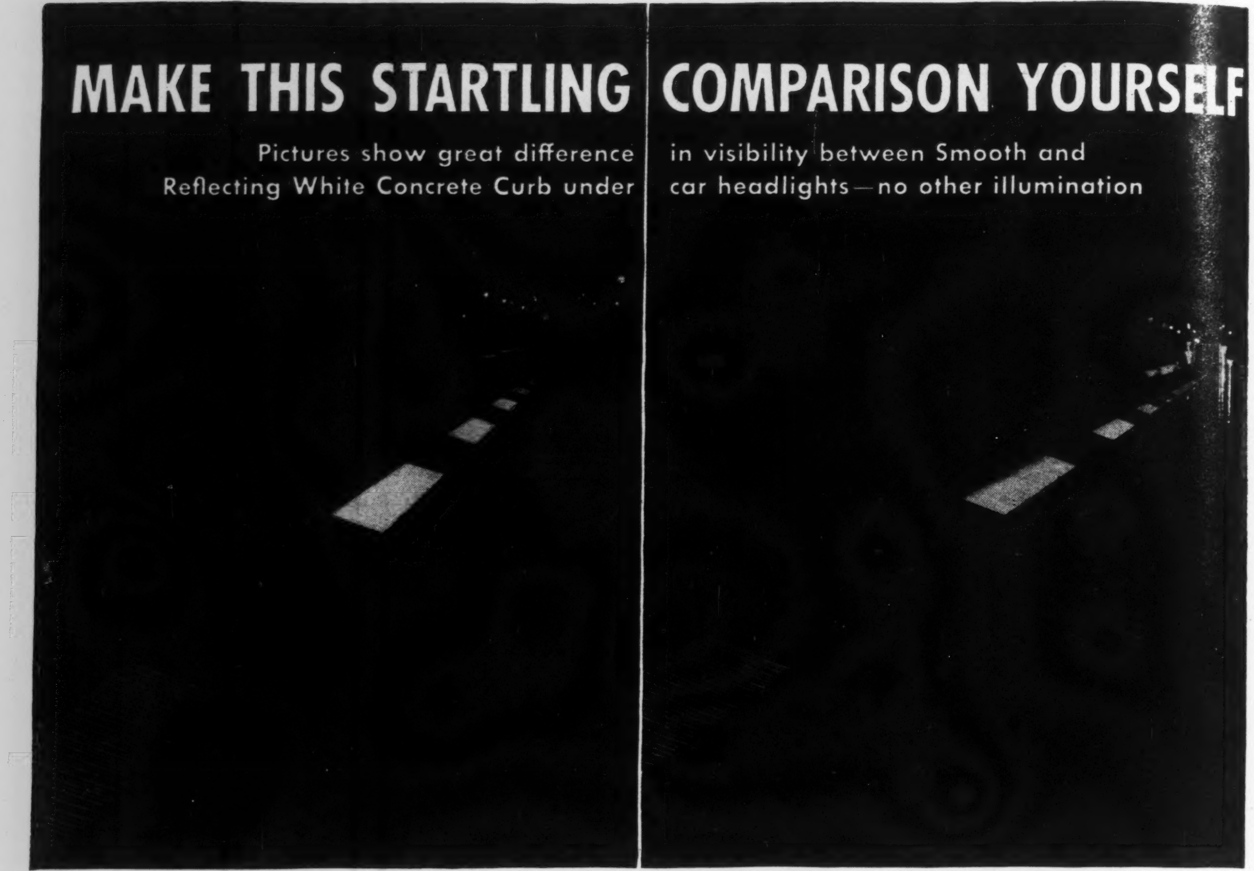
Engineering News-Record *reports projects of the following minimum costs;—water-works, excavation, drainage and irrigation,* $15,000; *other public works,* $25,000; *industrial buildings,* $40,000; *other buildings,* $150,000

Five Weeks—Thousands of Dollars (000 Omitted)

							United States			
								Five Months		
Public Works	**New England**	**Middle Atlantic**	**South**	**Mid West**	**West of Mississippi**	**Far West**	**May 1941**	**1941**	**1940**	**Canada**
Waterworks	348	731	491	595	1,675	706	**4,546**	33,384	34,450	217
Sewerage	349	2,823	786	1,551	1,173	396	**7,078**	45,605	38,928	....
Bridges, public	899	4,190	2,422	2,514	2,909	829	**13,763**	47,951	44,049	557
Earthwork and waterways	1,104	1,944	2,117	550	3,424	3,310	**12,449**	71,167	112,011	....
Streets and roads	4,684	13,162	13,493	9,890	16,741	5,356	**63,326**	248,692	293,254	983
Buildings, public	6,481	23,263	33,124	36,272	12,556	13,832	**125,528**	855,729	152,652	4,913
Unclassified, public	5,134	8,398	12,395	699	17,713	13,062	**57,401**	312,495	69,309	5,528
Total public	**18,999**	**54,511**	**64,828**	**52,071**	**56,191**	**37,491**	**284,091**	**1,615,023**	**744,653**	**12,198**
Federal government (included in above classifications)	13,094	23,757	43,355	35,625	21,020	25,919	**162,770**	1,068,520	165,597	....
Private										
Bridges, private	....	....	2,304	....	....	....	**2,304**	5,191	3,287	....
Buildings, industrial	2,059	7,209	20,614	9,203	10,440	2,521	**52,046**	274,036	171,323	4,330
Buildings, commercial	1,660	26,187	4,975	4,561	3,570	11,149	**52,102**	258,138	167,093	1,380
Unclassified, private	641	1,292	10,516	938	3,265	2,176	**18,828**	99,794	50,497	685
Total private	**4,360**	**34,688**	**38,409**	**14,702**	**17,275**	**15,84[illegible]**	**125,280**	**637,159**	**392,200**	**6,395**
Total Engineering Construction:										
May, 1941 (5 weeks)	**23,359**	**89,199**	**103,237**	**66,773**	**73,466**	**53,337**	**409,371**	....	....	**18,593**
April, 1941 (4 weeks)	27,787	120,616	43,040	48,427	64,464	77,229	381,563	....	....	18,751
May, 1940 (5 weeks)	13,401	64,557	75,792	54,315	49,714	24,517	282,296	....	....	20,180
Five Months — 1941	**131,789**	**545,919**	**436,075**	**446,271**	**387,317**	**304,811**	....	**2,252,182**	....	**80,080**
Five Months — 1940	51,491	290,934	235,053	210,077	218,455	130,843	....	....	1,136,853	55,382

MAKE THIS STARTLING COMPARISON YOURSELF

Pictures show great difference in visibility between Smooth and Reflecting White Concrete Curb under car headlights—no other illumination



DRY NIGHT: Alternate 17-foot sections of smooth curb and reflecting curb made with identical white materials. Note high visibility of reflecting curb (bright sections), and low visibility of smooth curb (dark sections). *Reason:* Headlight rays striking the smooth curb are reflected forward, away from the driver. Hence, curb appears dark—its visibility is low. The same headlight rays striking the saw-tooth faces of White Concrete Reflecting Curb are reflected back to the driver. Hence, the curb is highly visible.

RAINY NIGHT: Contrast in visibility is even more startling—the dark sections appear darker, and the light sections appear brighter. *Reason:* Water has filled in the minor indentations in the concrete—intensifying the mirror effect. Hence, smooth wet curb reflects almost all headlight rays forward—away from the driver—on rainy nights. The wet faces of the reflecting curb direct even more light back to the driver, and so provide an even brighter, whiter guide to safety just when the motorist needs it most.

Which type of curb would **YOU** *trust with* **YOUR** *life?*

SAFETY depends largely upon visibility. Except in a few areas with overhead lighting, the driver's headlamps are the only source of illumination at night. This New Jersey State Highway Department visibility test shows how smooth curb wastes the headlamp rays by reflecting them forward, away from the driver, while reflecting curb conserves this light by reflecting it back to the driver. Thus White Concrete Reflecting Curb greatly increases visibility and makes night driving safer.

Get the whole story of how White Concrete Reflecting Curb makes night driving safer—at surprisingly low cost.

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ENR-M-21

WHITE CONCRETE REFLECTING CURB

MADE WITH ATLAS WHITE CEMENT

ATLAS WHITE

The Week In Engineering and Construction

ENGINEERING NEWS-RECORD • JUNE 5, 1941

Access road appropriation recommended by President

Requests $125,000,000, but sees no necessity at present for bringing nation's network up to military standards, which is estimated by PRA to cost $458,000,000.

Long-awaited Presidential recommendations on defense highways finally went to Congress this week, urging an appropriation of $125,000,000 for construction of such roads. The President's proposals differ markedly from the conclusions reached in the Public Roads Administration report on defense roads submitted in February, which recommended appropriation of $287,000,000.

Considerable sentiment exists in Congress for providing a larger sum than that suggested by the President. It is possible that the amount might be raised to as much as the full $350,000,000 needed for access roads.

President Roosevelt suggests that $100,000,000 be appropriated for access roads, in some cases to be entirely financed by the federal government but with local participation encouraged. The PRA report proposed $150,000,000 for this work. The President says that the PRA survey "indicated" that 2,594 miles of access roads were "of the utmost importance" in 204 areas and would cost $177,600,000. (No explanation is given of the discrepancy between these figures and the PRA report's statement that 2,830 miles of access roads were needed at 192 locations and would cost $220,000,000).

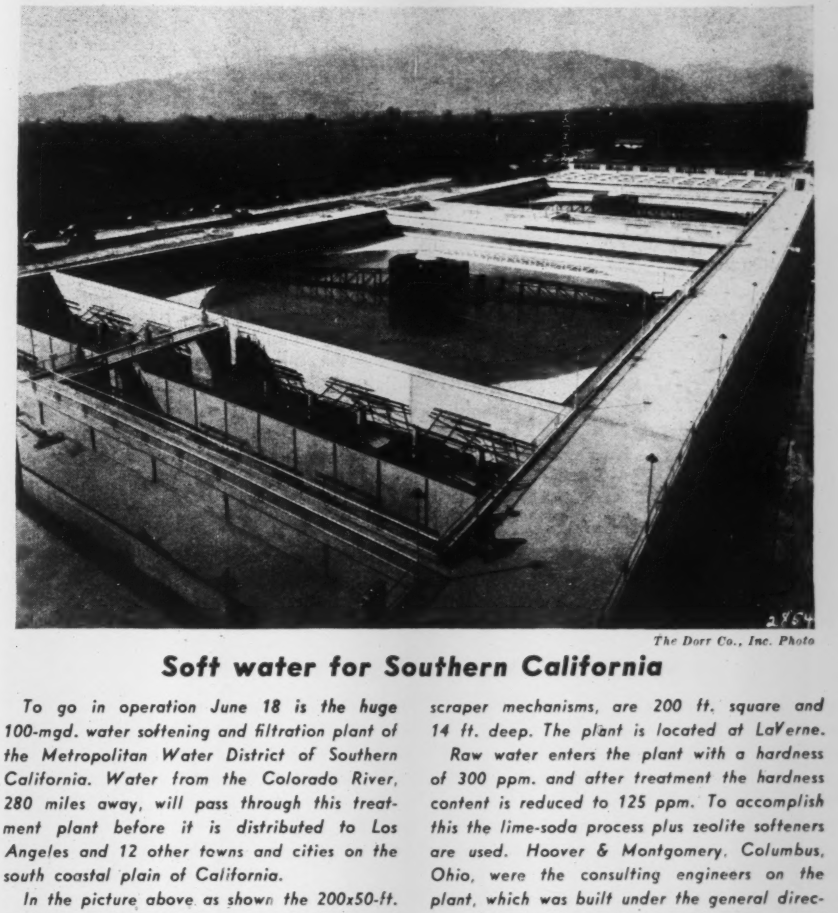
Through WPA and regular federal funds it has been found possible, the President says, to finance construction of 1,090 miles at a cost of $54,400,000, leaving $123,200,000 to be provided.

Many additions to PRA survey

The President points out that since the original PRA survey was made, 100 additional sites needing access roads have been found raising the total cost of access roads to $350,000,000. "It is my hope," he says, "that readjustments in highway programs now authorized may release additional funds for meeting in part these new requirements."

Although PRA reported that expenditure of $458,000,000 is needed to bring the 75,000-mi. strategic network up to minimum military standards, the President feels there is no necessity for undertaking this program now. He recommends that $25,000,000 be provided, to be matched equally by the states, for strengthening of bridges and some road widening in "key military areas." PRA had urged immediate appropriation of $100,000,000 for this purpose, with higher than normal federal participation.

The President's message made no mention of the PRA recommendations that $12,000,000 be provided for advance planning of improvements to the strategic network and that $25,000,000 be appropriated for improvements to "tactical" roads in maneuver areas and reimbursement of states for road damage caused by military movements.



The Dorr Co., Inc. Photo

Soft water for Southern California

To go in operation June 18 is the huge 100-mgd. water softening and filtration plant of the Metropolitan Water District of Southern California. Water from the Colorado River, 280 miles away, will pass through this treatment plant before it is distributed to Los Angeles and 12 other towns and cities on the south coastal plain of California.

In the picture above as shown the 200x50-ft. wide flocculators and the square clarifiers used in conditioning the water. The clarifiers, equipped with revolving sludge thickening and scraper mechanisms, are 200 ft. square and 14 ft. deep. The plant is located at LaVerne.

Raw water enters the plant with a hardness of 300 ppm. and after treatment the hardness content is reduced to 125 ppm. To accomplish this the lime-soda process plus zeolite softeners are used. Hoover & Montgomery, Columbus, Ohio, were the consulting engineers on the plant, which was built under the general direction of F. E. Weymouth, general manager and chief engineer of the Metropolitan Water District of Southern California.

New type of control placed on steel; Dunn predicts 1941 deficit

Need for producers to give preference to defense deliveries is emphasized by 1,400,000-ton deficit expected this year.

Government control over the distribution of steel took another step forward last week with the announcement by the Priorities Division of the Office of Production Management of a so-called General Steel Preference Delivery Order. This is a less rigid form of control than the industry-wide allocation now used for aluminum, nickel steel, and a number of other commodities. In essence, it formalizes the semi-voluntary preference which has been granted by the steel industry in the past to defense orders and at the same time provides a court of appeals for steel customers who are dissatisfied with the allocations made by the supplier.

The order directs producers of "pig iron, ferro-alloys, steel ingots and castings, and all carbon and alloy steel products" to give preference to orders entering into defense. Any customer whose order is rejected or who is unable to obtain prompt delivery may appeal to OPM on a form, PD-32, obtainable at Federal Reserve banks. OPM will thereupon order the steel producer to tell why the order was rejected or delayed and may order the producer to accept or advance the order.

The tightening situation in steel was emphasized by a revised version of the Gano Dunn report on steel supply submitted to the President last week. Mr. Dunn's initial report Feb. 28 set the maximum capacity of the industry at 91,125,000 tons annually, and predicted a surplus of 10,100,000 tons in 1941 and 2,100,000 tons in 1942. The revised version slightly increases the capacity estimate — to 91,339,000 tons — but greatly increases the estimate of demand so as to indicate a deficit of 1,400,000 tons this year and 6,400,000 tons next year. These figures use an estimate of domestic military demand, furnished by OPM's Bureau of Research and Statistics, of 12,400,000 tons and 13,800,000 tons for 1941 and 1942 respectively. Exports to Britain are estimated at 8,500,000 and 10,300,000 tons.

Civilian demand provides the most controversial estimates. Research and Statistics furnished an estimate of 72,500,000 and 88,600,000 tons for the two years. Mr. Dunn felt that these figures failed to take account of reductions in civilian activity, exemplified by the recently announced cut in automotive production, and that there was duplication between estimates of military and civilian demand. He therefore reduced these estimates to 58,200,000 tons for 1941 and 78,300,000 for 1942. The figure finally used for civilian demand in 1942 was arrived at by splitting the difference between this adjusted figure and an estimate of 68,500,000 tons furnished by the Iron and Steel Institute.

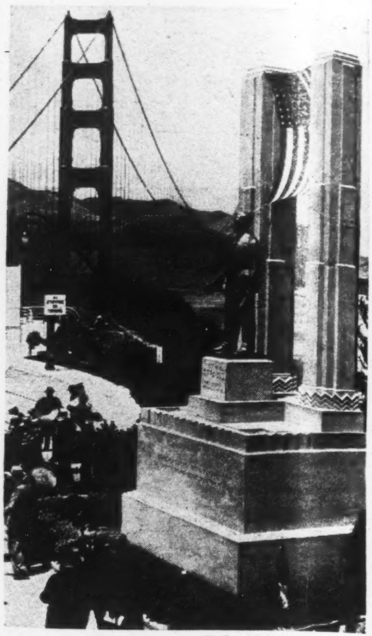
Mr. Dunn concludes that either steel capacity must be expanded or civilian consumption must be cut. He points out however that an expansion of 10,000,000 tons annually would cost $1,250,000,000, would take two years to provide, and would itself use 4,160,000 tons of steel.

News-Record publisher

John Abbink, president of Business Publishers International Corp. and a director of the McGraw-Hill Publishing Co. has been appointed publisher of Engineering News-Record and its associate magazine, Construction Methods.

To his new position Mr. Abbink brings a background of more than twenty years' experience with the construction field and the manufacturers of construction equipment, which began when he joined the McGraw-Hill Publishing Co. in 1921 as manager of the Spanish language engineering magazine, Ingenieria Internacional. Four years later by merging the overseas publications of McGraw-Hill and the Chilton Co. Business Publishers International Corp. was established, and Mr. Abbink became president.

Along with his new duties Mr. Abbink will continue as president of Business Publishers International Corp.



Redwood Empire Assn. Photo

Strauss monument unveiled

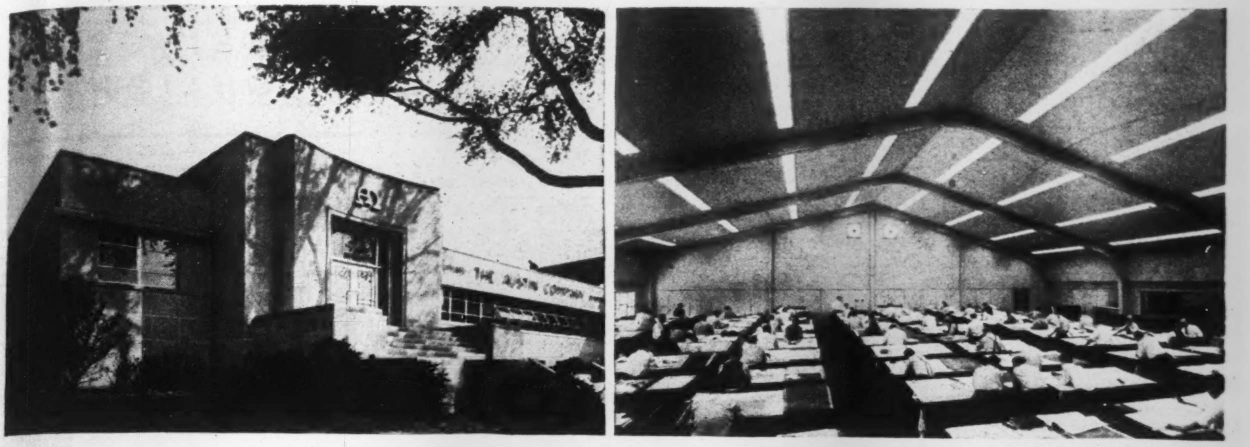
On May 28, four years after completion of the bridge across the Golden Gate, entrance to San Francisco Bay, ceremonies were held unveiling a bronze monument of Joseph B. Strauss, the man responsible for the design of the unprecedented 4,200-ft. span as well as for the organization of a district to carry out the project. Strauss died not long after the bridge was opened. The monument, shown above and erected by the Golden Gate Bridge and Highway District, consists of a bronze figure flanked by square concrete towers mounted on a large concrete pedestal which bears the inscription "Idealism and Action United to Form the Creative Power of This Achievement." The unveiling of the monument was done by Mrs. Annette Strauss, widow of the man honored by the monument.

Army engineers to start big Kentucky dam job

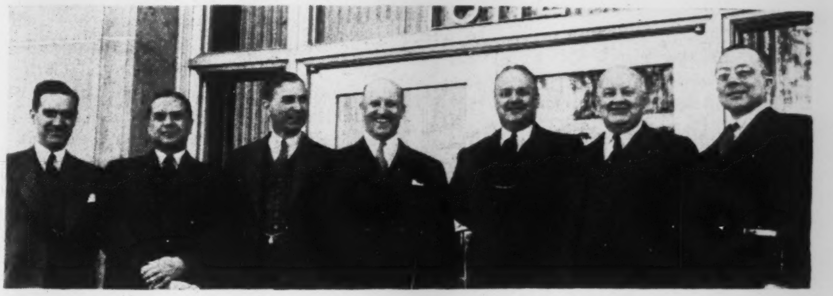
Last week Maj. O. E. Walsh, U.S. District Engineer at Nashville, Tenn., received orders to start immediately construction of the $55,000,000 Wolf Creek Dam project near Jamestown, Ky. The dam, which will be built on the Cumberland River, four miles downstream from the town of Rowenna in Russell County, will be for flood control and generation of 250,000 kw. of electrical power.

Bids are to be received June 17 or 18 for construction of necessary roads near the damsite and bids for actual construction of the dam June 27.

Wolf Creek Dam will be 238 ft. high and control a run-off of 5,110 sq.mi. It will consist of a 1,834-ft. concrete gravity section and 3,896 ft. of earth fill.



The Austin Company gets new engineering office



Several hundred members of The Austin Co., together with their families, joined May 24 in dedicating the company's new engineering building on Euclid Ave. in Cleveland to the memory of Wilbert J. Austin, president of the firm from 1924 until his death last December. An exterior view of the new structure is shown at the left, above, while at the right is shown an interior view of the clear working space for 100 engineers that has been provided by 70-ft. welded rigid frame arches. The drafting room is lighted entirely by eight bands of fluorescent tubes recessed in the acoustical ceiling.

The Austin firm now has 14 offices in the United States. Key men of those offices present for the dedication are shown at the right. They are, left to right: George W. Plaisted, general sales manager; P. C. McCabe, Chicago district manager; J. K. Gannett, New York district manager; George A. Bryant, president and general manager; A. F. Plant, Detroit district manager; H. F. Miter, Cleveland district manager; and Harold A. Hallstein, assistant general manager. Other executives unable to take part in the dedication ceremonies were: Albert S. Low, chief engineer; R. E. Ward, Los Angeles district manager; F. W. Maynard, Oakland (Calif.) district manager; W. R. Engstrom, Seattle district manager now in charge of special Austin work in the Puget Sound area, and Richard Ellis, acting district manager in Seattle.

St. Lawrence project now before Congress

New bill provides for start on power and navigation project. Temporary Niagara agreement also asked.

Legislation authorizing a start on the $409,000,000 St. Lawrence power and seaway project under the agreement between Canada and the United States was introduced into Congress this week. Hearings before the House river and harbor committee will start June 16. The bill, which provides no money, would authorize the Chief of Engineers to begin construction immediately and requires that the President negotiate with the state of New York to work out arrangements for repayment of its $93,375,000 share (stepped up from an original $90,000,000) in the cost over a 50-year period at 3 percent interest. Canada already had concluded an agreement with the province of Ontario whereby Ontario will pay $64,125,000 for power works on the Canadian side of the border. The bill permits negiotiated fee contracts for the construction work.

Full details of the St. Lawrence project as provided for in the agreement signed by representatives of the United States and Canada on March 19 were given in *ENR*, May 22 issue, p. 823. The total cost of building a 27-ft. waterway in the international section of the river and developing about 2,000,000 hp. is estimated at $266,170,000, of which the United States will pay $218,592,000 and Canada $47,578,000.

Also included under the agreement is channel deepening in the Great Lakes, a new lock at Sault Ste. Marie, remedial works to redistribute the flow at Niagara to permit larger diversions for power, deepening of the Welland Canal and construction of 27-ft. canals in the Canadian section of the St. Lawrence River. The total cost, including the work in the International Rapids, is $409,272,900.

It is not yet known whether the President plans to ask an appropriation for this project or to finance it from the $7,000,000,000 British-aid appropriation.

In an entirely independent action, the President last week asked Congress to approve a temporary arrangement with Canada by which an additional 5,000 cfs. of water would be diverted for power generation on the American side at Niagara Falls, and 3,000 cfs. more on the Canadian side. This water could be used for immediate generation of power in existing turbines. The arrangement would terminate Oct. 1, 1942. The plan is non-controversial and is expected to go through Congress quickly.

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Mexico to extend railway to Pacific Coast

The Mexican Government has available $8,200,000 for extending the Kansas City, Mexico and Orient Ry. from central Chihuahua state to Topolobampo a Pacific port in Sinaloa state. Surveys for the route now are in progress, according to Jesus de la Garza Gutierrez, minister of communications and public works. Mexican engineers have hopes of starting the work when surveys are finished, late this summer.

Susquehanna flood job reaches new stage

Binghamton U. S. Engineer district to have fifteen contracts underway on dam and levee work.

Before the end of the year the Binghamton U. S. Engineer District will have fifteen flood control contracts under way in its continuing project on the Upper Susquehanna River watershed. Protection work in this highly industrialized section of southern New York began in 1937, following the disastrous floods of the two previous years, and substantial progress has been made in the meantime. But this year will mark the largest number of simultaneous contracts under way. In addition to the flood control jobs, the Binghamton Engineer Office, under Maj. James C. Marshall, district engineer, has several defense airports in its charge, and is also making plans to handle design and construction of an air corps supply and repair depot near Rome, N. Y., which will be the largest Army air establishment in the Northeast.

Flood control in the Binghamton district is of particular importance because many defense contracts are concentrated in such cities as Binghamton, Corning, Elmira and Hornell, all centers of serious damage in 1935-36. The Southern New York Flood Control Project, official name for the reservoirs and local works contemplated in the $33,084,000 protection plan, involves two separate areas in the district, one in the northeast and one in the northwest.

In the northeast sector, work has been concentrated on the Chenango River which joins the Susquehanna at Binghamton; in addition to levees and channel work in two small towns, the principal job is Whitney Point Dam, located on the Otselic River which flows into the Tioughnioga and thence into the Chenango. Whitney Point Dam, which will provide 87,600 acre-ft. of storage, is 24 miles north of Binghamton, and will consist of a rolled earth embankment 90 ft. in maximum height and 900 ft. long, plus 3,200 ft. of dikes. A 220-ft. wide curved channel spillway is located in a rock cut in the left abutment, and there is a 13-ft. horseshoe conduit 1,425 ft. long tunneled beneath the spillway. With spillway and tunnel approaching completion, and about 1,500,000 yd. of fill in the dam, current operation involves construction of a cofferdam in the stream to divert water through the tunnel. The contractors, Hunkin-Conkey Construction Co., and Shofner, Gordon & Hinman, of Cleveland, will then start closure operations, which will require that 600,000 cu. yd. of fill be placed in 4 months. In Binghamton three contracts are under way which will protect the city from the Susquehanna River and residential areas from the Chenango River, and bids for the fourth section, consisting of various types of concrete walls along the Chenango River through the business section, will be opened June 9.

In the northwest sector, the Susquehanna's tributary, the Chemung, and its tributary, the Canisteo, are the center of present operations. Hornell is on the Canisteo and Corning and Elmira on the Chemung. Arkport Dam, a rolled earth embankment 1,200 ft. long and 113 ft. maximum height, and providing 7,950 acre-ft. of storage above Hornell, is in service. The next dam to be built is Almond (14,800 acre-ft.) also above Hornell; designs are nearly complete and $700,000 has just been appropriated for beginning its construction. Local protection works at Hornell are 90 percent complete. At Corning, levee work is 10 percent complete, while in its sister city, Painted Post, the local protection structures are ready for service. Bids for construction of a pumping plant at Corning to handle local drainage will be opened June 10. Levees and walls at Elmira are just getting under way.

The summer therefore will witness dam construction at Whitney Point and local protection work at Binghamton, Elmira, Corning and Hornell, while work is expected to begin on Almond Dam in the fall. The authorized plan contemplates four more reservoirs above Binghamton and local protection for four more towns. When all of the structures are in service, flood losses in these industrial cities can only be nominal instead of mounting to $16,000,000 of direct damage as they did in 1935, on top of indirect losses estimated to equal the direct damage.

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Dean T. U. Taylor dies; Texas educator

Thomas U. Taylor, 83, dean emeritus of the college of engineering at the University of Texas, died May 28 at Austin, following a long illness. Mr. Taylor was dean at the university from 1895 until 1936. Since the latter date he had held the title of dean emeritus. He graduated from the University of Virginia in 1883 and went to Texas in 1888. Before starting his long term of teaching, Mr. Taylor worked as principal assistant engineer to the state of Texas on survey work, as assistant engineer with J. A. L. Waddell on bridge design, and as hydrographer for Texas of the U. S. Geological Survey. During his teaching work he had served as consultant on water supply problems for the cities of Austin, Abilene, Dallas, Fort Worth and Wichita Falls.

Last year at the society's annual meeting in New York Dean Taylor was made an honorary member of the American Society of Civil Engineers after 38 years of full membership.

WASHINGTON HIGHLIGHTS

Appropriation of an additional $50,000,000 for naval public works has been recommended to Congress by the President. Biggest items are a $14,990,000 expansion of the Marine aviation base at Neuse River, N. C. and a $15,750,000 program of lighter-than-air bases.

Gov. Leon C. Phillips of Oklahoma lost in his U. S. Supreme Court fight to halt construction of the $54,000,000 Denison Dam on the Red River when the court this week upheld a lower court decision dismissing his suit. "The power of flood control extends to the tributaries of navigable streams," said the court.

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Congress gets big flood-control bill

A flood-control bill authorizing projects costing $260,000,000 and importantly modifying the Lower Mississippi River program was reported to Congress this week. The changes in the Lower Mississippi plan take advantage of the unexpectedly great success of the cut-offs to scale down the necessary work. The Boeuf and Eudora floodways would be abandoned under the committee's proposals.

The House committee adopted the Mississippi River Commission's so-called Plan 4 which provides for elimination of the floodways and maintenance of levees at a one-foot freeboard above the project flood. The committee modified this, however, by providing an extra two feet of freeboard on the east bank in order to perpetuate the naturally greater flood safety on this side.

This change will reduce the cost of the Mississippi work by about eight or nine million dollars below the authorized $70,000,000, but no change is made in the authorization.

Among the projects authorized are the following: Connecticut River, reservoirs $10,000,000 and local protection $6,000,000; Thames River (Connecticut, Rhode Island and Massachusetts), $6,000,000; Colorado River of Texas, $6,500,000; Brazos River, Texas, $5,000,000; White River (Missouri and Arkansas) $26,847,000; Arkansas River Basin (Oklahoma, Missouri and Kansas), $29,000,000; Ohio River Basin $45,000,000; Tennessee River, local protection, $13,500,000; Missouri River Basin (including Republican River), $7,000,000; Los Angeles-San Gabriel River Basin and Ballona Creek, $25,000,000; Sacramento River, $10,500,000.

Mississippi contractors need not pay sale tax

The state tax collector of Mississippi does not have the right to sue for about $1,000,000 alleged due as back sales taxes from contractors employed on that state's recent $90,000,000 highway paving program, according to the Mississippi State Supreme Court in a recent ruling. The decision is based upon an opinion that the administration of the sales tax law of that state is vested exclusively in the chairman of the state tax commission.

The decision was handed down on one of 300 suits filed by Carl N. Craig, state tax collector. The case actually decided was that against the Dunn Construction Co., in which $54,032 was sought on the basis of a one-percent levy on the contractor's materials. The decision reverses a Hinds County circuit court ruling, which dismissed demurrers attacking the state tax collector's authority to maintain the back sales tax suit against the Dunn Company.

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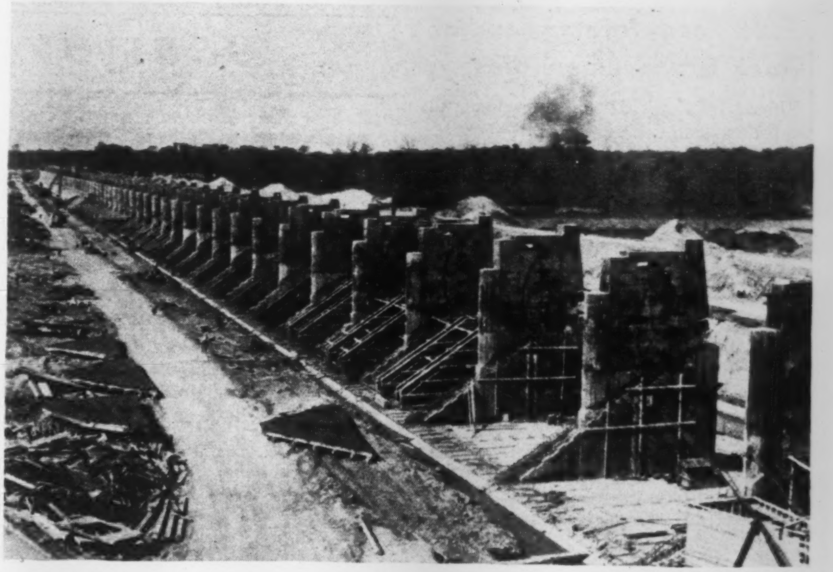


Wide World Photo

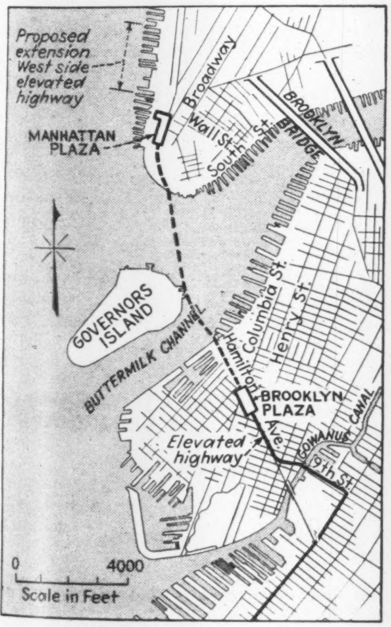
Long spillway for Santee Dam of Santee-Cooper work

Upstream side of the 3,400-ft. spillway for the 8-mile long dam across Santee River valley for the Santee-Cooper power and navigation project in South Carolina is shown above. The Santee River has a maximum recorded flood of 368,000 cfs. This spillway will have a capacity of 500,000 cfs. at El. 75, normal highwater level in the reservoir, and 800,000 cfs. at El. 80. Crest of the earthfill dam is at El. 88. (For fuller details of dam's construction see ENR, May 23, 1940, Vol. p. 708.)

The spillway is of reinforced concrete construction topped by 65 tainter-type crest gates each 50 ft. long. It is carried on a wide slab of reinforced concrete laid directly on a bed of firm sand in the river bottom at the site. A steel cutoff wall was driven to impervious material under the upstream toe of the slab.

New York tunnel work goes to Flinn firm

When bids were opened May 27 for the construction of the Brooklyn section of the Battery-Brooklyn vehicular tunnel under the East River at New York, the George H. Flinn Corp., New York, was low bidder with a bid of $13,888,000. A few days later the Flinn organization was given the contract for the work and told to proceed with construction. The second low bidder was the S. A. Healey Co., White Plains, N. Y., with a bid of $14,345,000, and the Rosoff Tunnel Corp., New York, third with $15,795,000.



The Flinn contract will include all work on the tunnel's twin tubes from the construction shafts at Hamilton Ave. and Summit St. in Brooklyn to Governors Island. The rest of the other tunnel proper will be placed under contract at an early date. Location of all the work is shown by the accompanying map.

Each of the tunnel tubes will consist of a circular cast iron shell, lined with concrete. Roadway width will be 21 ft. for each tube; the annual capacity for both tubes is set at 16,000,000 vehicles.

The tunnel is scheduled to be opened to traffic in the summer of 1944.

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Damages awarded in Minnesota building case

The first damage suits to be tried growing out of the collapse Oct. 27, 1937 of an old brick building in Minneapolis used by the Morris Fruit Co. were settled last month at the Twin Cities. Jurors granted a switchboard operator of the Morris firm $12,500 for injuries she suffered in the building collapse, and awarded $10,000 to a widow of a salesman who was one of two killed when the structure collapsed.

Verdicts in the two cases decided were against the Barlwo Realty Co., owners of the building. Originally the Ernest N. Ganley Co., which remodeled the building after a fire in 1933, had been named a defendant, but the court held that the company was not negligent in the work it had done. The Morris company was not named in the suits.

Details of the building collapse are given in *ENR*, Nov. 4, 1937, p. 731.

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New York parkway extension completed

On May 30 the Sheepshead Bay section of the Belt Parkway in New York City was opened to traffic. The new section bypasses Emmons Ave. and extends from Ocean Parkway to Knapp St. in Brooklyn. At present two lines of traffic are provided in each direction, but provision is made for an additional lane.

The only sections remaining to extend the Belt Parkway to the Battery-Brooklyn Tunnel is the elevated Gowanus Parkway and surface improvements from Owl's Head Park along 3rd Ave. and Hamilton Ave. to the Brooklyn plaza. This work is now under construction and will be completed this fall. The work just completed and that in progress is being done by the Triborough Bridge Authority.

R. H. Ford, former head of Rock Island Lines, dies

Robert H. Ford, 72, chief engineer of the Rock Island Lines until his retirement two years ago, died May 27 in Chicago. He was born in St. Albans, Vt., Sept. 8, 1869, and went into railroad work immediately upon graduating from Norwich University in 1892. His first job was with the Central Vermont Ry., which he served for 13 years. In 1906 Mr. Ford joined the Missouri Pacific, rising to assistant chief engineer, maintenance-of-way by 1911, when he resigned to join Hodge-Downing Const. Co. of Birmingham. Two years later he was back in railroading, this time with the Rock Island. He was appointed chief engineer April 1, 1937, and retired Sept. 30, 1939.

Kaufmann & Fabry Photo

R. H. Ford

Mr. Ford served on many committees of the American Society of Civil Engineers, the American Railroad Engineering Association and the Association of American Railroads. In 1935-36 he was president of the A.R.E.A., and was a director at the time of his death. Deeply interested in engineering education, he participated in educational work of the A.S.C.E. and A.R.E.A., and had been a trustee of Norwich University for many years.

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Pennsylvania may build another toll road

The Senate of the State of Pennsylvania May 15 passed a bill providing for the construction of a 50-mile highway along the top of the Pocono Mountains in the Delaware Water Gap region. The new route, if built, would be operated as a toll road. The state highway department estimates the cost of the project at about $15,000,000.

JOBS OF THE WEEK

ROLLING MILL, Chicago, Ill.

Revere Copper & Brass, Inc., Chicago, Ill., has awarded the general contract for a foundry and brass plate rolling mill to James Stewart Corp., Chicago. Total estimated cost, including equipment, is $10,000,000. Revere Brass & Copper, Inc., will operate plant for the War Department. Johnck & Ehmann, Chicago, are engineers and architects, for the work, which is financed by the Defense Plant Corp., a subsidiary of the Reconstruction Finance Corp.

FACTORY FOR FORGINGS, Toledo, O.

War Department, Washington, has completed a lease agreement with Willys-Overland Motors, Inc., Toledo, Ohio, for acquisition and rehabilitation of the buildings, including installation of necessary machinery, for manufacturing forgings. Total estimated cost of the work is $2,172,000. It will be financed by the Defense Plant Corp.

SHIPWAYS, Los Angeles, Calif.

California Shipbuilding Corp., Los Angeles, will construct six shipways with its own forces. U. S. Maritime Commission will finance the work, which is estimated to cost $4,330,000.

MACHINE GUN PLANT, Windsor, Ont.

Dinsmore-McIntire, Ltd., Windsor, Ont., will construct an $8,000,000 machine gun plant to be operated by General Motors Corp. of Canada, Ltd., for the Department National Defense, Ottawa, Ont. Allward & Gouinlock, Toronto, are architects for the project.

DRYDOCK, Portsmouth, N. H.

Aberthaw Co., Boston, Mass., has received a $2,500,000 cost-plus-fixed-fee contract for construction of a drydock at Navy Yard for the Bureau of Yards & Docks, Navy Department, Washington, D. C.

SHIPWAYS, South Portland, Me.

South Portland Shipbuilding Corp., South Portland, Me., will construct four shipways for the U. S. Maritime Commission, Washington, D. C. The work is estimated to cost $3,000,000.

HIGHWAYS, Clayton, Mo.

St. Louis County Highway Department, Clayton, Mo., is grading and paving with macadam or concrete various highways. Work includes a road to Jefferson Barracks, an access road to the Lambert-St. Louis Municipal Airport, extension of the Delmar Blvd. between Old Bonhomme and Price Rds., improvement of Wild Horse Creek Road, extension of Hencken Rd. south from Manchester Rd. to Rockwoods Reservation, and construction of a bridge over Gravois Creek at Weber Rd. with WPA labor. Estimated cost of all the work is $2,399,003. Roy Jablonsky, Clayton, is county engineer.

HOUSING PROJECT, Linden, N. J.

Clifford F. MacEvoy Co., Newark, N. J., received the contract for constructing 700 frame houses for a defense housing project for Kearney shipyard workers. The work is being done for the Federal Works Agency, Washington, and is estimated to cost $2,500,000. John T. Rowland, Jersey City, is architect for the project.

PIPELINE, Louisiana and North Carolina

Ford, Bacon & Davis, Inc., New York, N. Y., received the contract for a $15,000,000 pipe line from Baton Rouge, La., to Greensboro, N. C., from the Plantation Pipe Line Co., New York, N. Y.

STORAGE FACILITIES, Bayonne, N. J.

Wigton-Abbott Corp. and Mahony Troast Construction Co., Plainfield, N. J., have been awarded a $5,723,000 supplementary contract for the storage warehouse facilities at the Naval Supply Depot by the Bureau of Yards & Docks, Navy Department, Washington, D. C.

LANDING FIELDS, Alaska

War Department, Washington, D. C., will construct landing fields at Yakutat and Annette Island by force account. Estimated cost of all work is $2,500,000.

NATURAL GAS PIPELINES, Louisiana, Alabama and Georgia

Ford, Bacon & Davis, Inc., New York, have been awarded a contract for extending the natural gas pipeline system from Monroe Field, La., to Birmingham, Ala., and to Atlanta, Ga. Southern Natural Gas Co., Birmingham, Ala., is doing the work, which is estimated to cost $7,000,000 to $8,000,000.

NOTE—Additional bidding and contract news on over 800 projects large and small appear in the Construction News section beginning on page 137.

OBITUARY

Col. C. H. Birdseye, 53, former chief topographic engineer of the U. S. Geological Survey and at one time president of the Aerotopographic Corp. of America, died in Washington, D. C. May 30. Mr. Birdseye, a graduate of Oberlin University served with the Corps of Engineers in France during the World War. After a period of teaching at the University of Cincinnati, he joined the Geological Survey in 1906.

Josiah A. Briggs, 89, who supervised the building of a 4½-mi. Grand Boulevard and Concourse project in New York City as chief engineer of the Bronx in 1910, died May 27 in Yonkers, N. Y. After leaving the Bronx Department in 1910, Briggs maintained his own office.

Elmer J. McCaustland, 77, dean emeritus of the school of engineering at the University of Missouri, died May 16, at Albuquerque, New Mexico. Mr. McCaustland, a graduate of Cornell University, had worked as instructor in civil engineering at Cornell University, and as a member of the Washington State Board of Health.

Heber E. DeLong, 50, a construction engineer at the Socony-Vacuum Oil Co. on a Paulsboro, Pa. project was killed by a falling steel girder May 29.

Otto M. Winklesky, engineer for the St. Paul, Minn., department of public works for 22 years, died last month.

Eliot B. Parsons, city engineer of Watertown, Wis. and formerly city engineer at Fond du Lac, Wis., died recently.

Adrian R. Wadsworth, 85, former city engineer of Shamokini, Pa. and builder of railway bridges in Virginia and West Virginia, died May 15 at Farmington, Conn.

Coleman B. Wheaton, 51, chief engineer of the municipal light and water department of Washington, N. C., died May 27. He had been connected with the city engineering staff for 30 years.

Wilson Keenan Martin, 49, president of the W. K. Martin Construction Co., a Kansas City building firm, died May 26.

Mack Williams, PWA engineer for a courthouse and jail job at St. Albans, L. I., N. Y. died last week at the age of 63.

CONTRACTS AND CAPITAL

Engineering Construction awards for the week, $132,570,000, reach the fifth highest peak of the year and are 104 percent above the volume for the corresponding 1940 week.

State and municipal construction is at the highest level since November 16, 1940, and is 13 percent higher than a year ago. This peak volume, in combination with the 913 percent increase in federal work, brings public construction to its fifth highest point of the year, and 96 percent over last year.

Private awards for the week are 133 percent higher than the 1940 weeks' construction totals.

The current week's volume brings 1941 construction to $2,384,752,000, a 99 percent increase over the opening 23-week period last year. Private awards for the period are up 65 percent, and public construction is 116 percent greater as a result of the 555 percent gain in federal work.

New capital for construction purposes for the week totals $10,704,000, a decrease of 33 percent from a year ago. The week's financing is made up of $7,541,000 in state and municipal bonds, $2,716,000 in corporate security issues, and $447,000 in RFC loans for industrial plant expansion.

CONTRACTS

(Thousands of dollars)

	Week Ending June 6 1940	May 29 1941	June 5 1941
Federal	$4,677	$20,175	$47,398
State & Municipal	46,049	20,876	52,000
Total public...	$50,726	$41,051	$99,398
Total private..	14,241	29,317	33,172
TOTALS	$64,967	$70,368	$132,570

Cumulative
1941 ......(23 weeks).... $2,384,752
1940 ......(23 weeks).... $1,201,820

Note: Minimum size projects included are: Waterworks and waterways projects, $15,000; other public works, $25,000; industrial buildings, $40,000; other buildings, $150,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1940 23 weeks	1941 23 weeks
NON-FEDERAL	$597,269	$391,147
Corp. Securities ..	84,889	114,258
State & Mun......	427,126	224,546
U.S.H.A. loans.....	78,430	22,550
R.F.C. loans........	6,824	29,793
FEDERAL	.....	$2,891,337
TOTAL CAPITAL....	$597,269	$3,282,484

FHA MORTGAGES

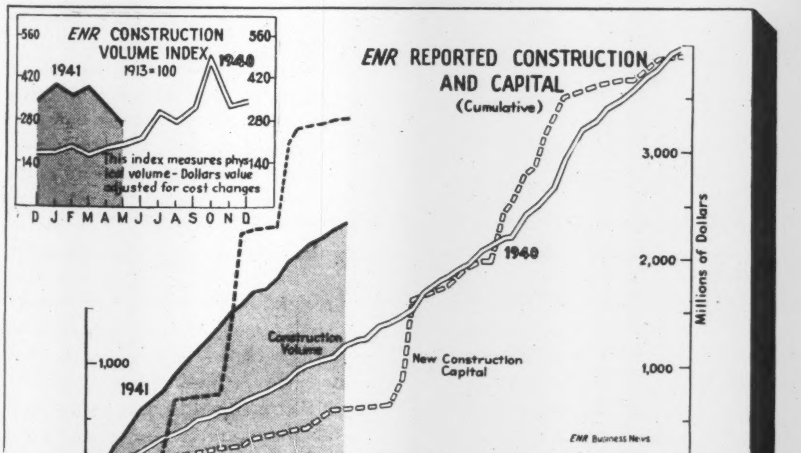
	Week Ending June 1 1940	May 24 1941	May 31 1941
Selected for appraisal ...	$22,787	$36,331	$28,000*

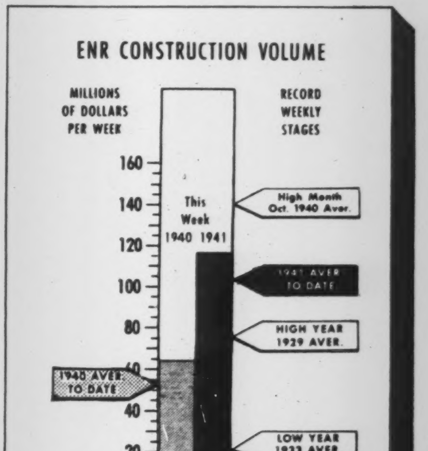
Cumulative
1941 ......(22 weeks).... $620,420*
1940 ......(22 weeks).... $526,867

* Subject to revision.

ENR INDEX NUMBERS

Index Base=100		1913	1926
Construction Cost..	June '41..	256.79	123.44
Building Cost	June '41..	209.41	113.20
Volume	May '41..	275	121





Comment and Discussion

Readers' opinions on matters that concern engineers and contractors

Soil-Cement Runway Paving

Sir: Referring to the article on soil-cement runway paving at Westover Field (*ENR* April 10, 1941, p. 531), the 54c. per sq.yd. figure which you mention as the cost of the contract work is correct, but the article may be slightly ambiguous in not bringing out the fact more strongly that there was additional expense incurred by WPA in doing the grading and in hauling the surfacing material from a nearby pit. If the natural soil had been satisfactory and the ground at the correct elevation, the contract price would have covered the entire cost of the job. Excellent results were obtained on this work because it is really mixed-in-place concrete of low cement content, with a clean, sandy gravel for aggregate rather than the natural soil.

Carl H. Lovejoy
Area Engineer, Westover Field
U. S. Engineer Department

Early Suspension Bridge Ideas

Sir: I submit herewith an interesting enlargement of our historical knowledge of suspension bridge failures. The excellent paper of Prof. Finch in your March 13 issue in discussing the failure of the Niagara-Clifton suspension bridge, which occurred on Jan. 10, 1889, states that the mode of oscillation was unknown. I quote the following with regard to this bridge from an English treatise on "Civil Engineering as applied to Construction" by Vernon-Harcourt, which was first published in 1901: "The wind, rising from below in a gorge relieves the chains to some extent of the weight of the roadway and produces *undulations* in a light platform which attain their *maximum* about *halfway between piers* and *center of span*."

This could be said of the Tacoma bridge and of all other suspension wind failures where a specific statement of the mode of distortion at failure is available.

In 1847, Squire Whipple, who ranks with James Watt and others as an engineering pioneer and whose work was as fundamental to bridge analysis as that of Watt was to the steam engine, had this to say in his essay on "Bridge Building" about *undulation* of suspension bridges:

"I have a plan which is believed to be original and which is certain to obviate difficulties of *undulation* and render the suspension bridge as applicable to railroads as common roads. It is not, however, to be expected, that a bridge can be built that will sustain a railroad train of hundreds of tons, at so small an expense as will suffice for a common road bridge, seldom required to support more than a few thousand pounds." Mr. Whipple then indicates in a sketch the type of rigid suspension used in the sky-ride at the Chicago "Century of Progress" exposition. Such a scheme would give rigid suspension but would not be practical for long highway spans.

It is important though, that Whipple and other engineers prominent in the history of bridge engineering have recognized the fundamental dynamic instability of the suspension bridge which gives rise to "undulations." We may feel certain that the extreme importance of the historical background of suspension bridge construction will never again be ignored and may hope that the next long span suspension structure will be a fundamentally rigid rather than a flexible type of bridge.

G. A. Maney
Northwestern Technological Institute
Evanston, Ill.

Trees in Median Strips

Sir: In the case of divided roadways such as the Merritt Parkway in Connecticut, why not make use of a continuous line of evergreen trees in the center of the grass dividing island to serve as a shield to cut off the glare of approaching headlights at night?

I presume that the landscaping department feels scattered planting, as they do it, is more artistic, but the same number of trees and bushes regimented in one row would be a blessing to the eyes of tired drivers, who have to face the sometimes blinding lights of approaching cars. Such a method of planting would facilitate the cutting of grass.

In other cases, where there are roadways in opposite directions divided by only a narrow curb, it might be desirable to erect a tight high fence of some kind to hide the opposing lights.

I feel sure that planting of this kind would greatly reduce one of the present hazards of night driving.

Arthur P. Porter
Structural Designer, Panama Canal
Diablo Heights, C. Z.

Sacrifice and Cooperation

Sir: In your issue of April 24th, 1941, there appears an editorial entitled "A Planned Depression", in which you point out that our whole economy is being warped toward preparation for war and everyone knows it must eventually be shifted back, and we hope without shock. You point out that whether or not shock can be avoided depends on quality of planning done now.

In a recent address Charles E. Wilson, president of the General Electric Co., discussed this subject in a broad way, and called for an "arm in arm accord" among business, labor and government, from which there might come a program including a recovery stage, a stabilizing stage, a back-log building stage and the after-the-war stage. Mr. Wilson's address indicates that we have in this country the experience, ability and faith needed to prepare for a possible depression even while going all out in our defense program, and he also indicates the difficulties to be surmounted.

The principal difficulty, as we all recognize, is the existence in this country of many so-called pressure groups, each having the laudable purpose of improving the conditions of its members, but some groups are fighting others, and all are trying to put pressure on governmental agencies to advance their cause. It seems obvious that whatever is best for the country as a whole is in the long run best for each of these groups, and since they are pulling at cross purposes, the methods they advocate cannot all be sound. If some method could be found to pool their intelligence, enthusiasm and faith, it seems probable that a wise plan would emerge, and Mr. Wilson offers the age-old tried and true way to secure such a pooling of interests. That is, for our foremost business and industrial leaders to hold out the olive branch to those who oppose them, offer to join in asking Divine guidance to find the right plan, and agree to take their share of the sacrifices such a plan may impose. This gets back to your editorial in which you point out that whether or not shock can be avoided depends on the quality of our planning.

JOHN G. EADIE
Eadie, Freund & Campbell
Consulting Engineers
New York, N. Y.

Credit for Contractors

Sir: A little while ago the huge ordnance plant constructed at Radford, Va., for the Hercules Powder Co. and the federal government by the Mason and Hanger Co. of New York was dedicated. This $44,000,000 plant was completed in about six months, 90 days ahead of schedule time—an amazing performance. During the dedication ceremony there was not a word of commendation for the contractors, nor for their capable, responsible men who worked day and night to achieve the astonishing result.

The contractors doing defense work have been selected from among the leading organizations of the nation; selected for their ability, experience and their record of past performance.

It requires peculiar skill, long experience and almost perfect cooperation and coordination to do millions of dollars worth of emergency construction work in a few months. Management ability of high order is required.

The picture is not so rosy for the contractors as the uninformed think. The very best of their organization and plant are devoted to their defense work; their civil work almost always suffers. Defense work comes first, civil work second; the contractor foots the consequent bill. The fees paid are not large; no one can deny that patriotism and love of country is not a motive, too.

I have just finished reading an article in "Construction", published in Baltimore, describing the difficulties in building a causeway over marshland in South Carolina. The only mention made of the contractor is, in listing some of the difficulties of the work, "A bad storm which drove the contractor's dredge on high ground and scattered his pontoon lines over a mile from the site, thus requiring 23 days to get back to work." The contractors in this case were the Merritt Dredging Co. of Charleston, S. C. Of course, the credit for doing a difficult job of this sort is due both to engineer and contractor. But why is it that in so many, many cases, the contractor gets no recognition except some general reference as noted above?

I am sure that it would be heartening to defense work contractors, all contractors, if more officials would give some public recognition to their contribution to defense and public improvements.

H. O. LOCHER
Secretary, National Association of
River and Harbor Contractors
New York, N. Y.

Economy Through Better Design

Sir: If we are approaching a period when conservation of construction materials will be desirable, there are a number of changes in design practice, particularly as prescribed by building codes, that would aid such conservation.

Fiber stresses in structural steel could be raised from the present allowable of 18,000 and 20,000 lb. to 22,000 per sq.in.

Continuity could be taken advantage of in the case of more than two successive spans; the labor involved in the development of continuity moments does not offset the economy in material saved by the use of such design.

In the design of columns economy could be effected by considering the columns fixed at top or at bottom or at both ends, instead of disregarding end conditions as at present.

Design stresses for 3,000-lb. (28-day) concrete could be raised from the present 1,200 to 1,500 lb. per sq.in.

Reinforcing steel stresses could be made 20,000 and 22,000 lb. per sq.in. respectively for intermediate and harder grade, for bars $\frac{1}{2}$ in. and over. For smaller sizes, 24,000 lb. per sq.in. could be used. Also, the stresses for web reinforcement could be raised to 20,000 lb. per sq.in.

Protection of steel in reinforced concrete slabs not exposed to severe weather can be $\frac{1}{2}$ in. instead of $\frac{3}{4}$ in.

Lateral spacing of parallel bars in concrete beams and girders could be closer because vibration can be used in placing the concrete; closer spacing would permit narrower beams.

Many other code provisions now in use could be changed with much benefit to the economy of materials and without sacrifice in the strength of buildings.

ARNOLD A. WEITZMAN
Detroit, Mich.

Plotting Points on Curves

Sir: In *Engineering News-Record* March 13, p. 423, Charles S. Synyard comments on an item of mine that appeared in the "Field and Office" section of the issue of Nov. 17, 1938.

My principal reason in submitting the item was not the introduction of new or unheard of mathematical formulas, but rather to suggest the possibility of using the slide rule for the computations in question as it has been my experience that there are many engineers who always keep their slide rules within reach but never use them for angle computations regardless of the degree of approximation to be permitted in the result.

While the method of computation submitted by Mr. Synyard is correct, it involves the use of the versed sine, which renders it unsuitable for slide rule computations. This can be illustrated by using his sample computation for "$N2$"; $N2 = 1910.08$ versin 6 deg. To find the versed sine of 6 deg. on the slide rule we would first get the cosine of 6 deg.; which is equal to the sine of 84 deg. or about 0.995. Then, versin 6 deg. $= 1 -$ cos 6 deg. $= 1 - 0.995 = 0.005$, a result that is largely dependent on luck, and even at that it is of an accuracy that is somewhat inferior to a good guess.

On the other hand the method that was suggested in my item will enable the slide rule to give results in the above case to about the nearest tenth of a foot, which is ordinarily close enough for plotting on a forty or fifty scale plan.

As far as convenience and simplicity are concerned, it is my opinion that these questions are largely a matter of circumstances, wherein the personal factor plays a large part. In my own case I am much more likely to have a slide rule handy than a table of versed sines.

THOMAS C. COLEMAN
West Somerville, Mass.

EDITORIALS

VOLUME 126 NUMBER 23

June 5, 1941

Unlimited

THAT THE NATIONAL EMERGENCY which the President proclaimed on May 27 as "unlimited" is a call to arms, even the most reluctant must admit. A declaration of intent, too long postponed when time is the bottleneck, it points our path for the future. But what the President said in the statement accompanying his proclamation was relatively less important than the fact that he said it. It may now be assumed to be national policy to prevent strikes, to control prices, to put shipbuilding on a par with armament manufacture, to extend our fortifications on the near-side Atlantic islands and to seize strategic far-side islands, even African Dakar, if they are threatened by a hostile power. For the construction industry this policy promises better federal support in its efforts to build the factories and other facilities for defense with greater efficiency and speed; and it suggests more work abroad to bring outlying bases up to maximum usefulness. If the national emergency is unlimited, the opportunities for speedier national defense that its recognition opens up are also relieved of restrictions. It is a good omen.

Priorities are Coming

ONE OF THE FIRST EFFECTS of the new unlimited emergency status will be a broadening of the priorities system through which the products of our factories are siphoned off to the defense jobs that need them most. So far there has been a good deal of dallying, procrastination and punch-pulling about the imposition of priorities. A more realistic attitude is now bound to emerge, for national defense jobs must not be restricted; and when it does the construction industry is certain to feel its effects. There will of course be red tape for the defense construction contractor; there will be delays for the construction contractor whose job is important but not urgent; and there will be the necessity for the non-defense construction contractor to take what he can get when he can get it or to devise a substitute. All this is regrettable but necessary if our defense is to be ready on time. Since a priorities system is complicated at best, it must be understood if it is to operate efficiently. As clear and concise a presentation of the present system of controls as it has been possible to assemble is presented on another page of this issue. It should be read with studious care, for priorities are coming to construction. Knowing "too little" about priorities "too late" is one thing the construction industry should try to avoid.

Roadbuilding in South America

HIGHWAY BUILDING in South and Central America daily becomes of more significance to engineers and contractors of this country as they realize that world events are making it necessary for this country to aid its neighbors to the South in developing better internal transportation. Thus the article in this issue on the highway work in Paraguay, being carried forward under the direction of American engineers and contractors with American construction equipment, has more than passing interest. It may be a preview of one of the important roadbuilding fronts of the future.

Money for Access Roads

AT LONG LAST the President has asked Congress for money to start work on much-needed roads to give access to military camps and to serve new defense industries. On June 2 he sent Congress a request for $100,000,000 for access roads and $25,000,000 to strengthen bridges and widen roads on the defense highway network. A recommendation that $287,000,000 be appropriated for access and defense roads has been on the President's desk or in the hands of some executive agency since the first of February. Meanwhile, much needed work has been held up except where the WPA could provide funds or state highway departments found it possible to switch some of their federal-aid money to access road work. Now that Congress has the President's recommendations, the prompt action that may be expected is indicated by the immediate introduction by Senator Hayden and Representative Cartwright of legislation to put the President's proposals into effect. This legislation sets no limit on the amount to be spent, thus making it possible to meet unforeseen future needs without further legislation. Such flexibility is highly desirable as the amount now needed for access roads alone, according to the Public Roads Administration, has risen to $350,000,000, since February. Still unknown is the amount of money that must be spent on our strategic highway net to make it adequate to handle a large motorized army without crippling the movement of supplies to the civil population and defense industries. Ability to meet all of these needs quickly is imperative.

Structures and Beauty

It is worth recalling now and then that engineering structures, besides performing their primary function of service, by their very appearance often contribute something to the satisfaction of living. Few there are who were not thrilled by their first views of the Empire State Building, Bartlett Dam, the towers and anchorages of the Whitestone Bridge, the portals of the Pennsylvania Turnpike tunnels, New York's Tallman's Island sewage plant, the desilting works of the Colorado Aqueduct or the Milwaukee water treatment plant, to mention only a few engineering structures that readily come to mind. Widely different in surroundings, form and function, all lack obvious effort to conceal their purely utilitarian character, yet all have the natural beauty that wins acclaim.

Not many years ago such results would have been impossible. Engineers were reluctant to let taste and sense of proportion temper their calculated designs. Public standards of beauty were still under the spell of nineteenth century post office esthetics, and works of utility were held to be inherently unattractive unless disguised by applied ornament. Happily those days are past. Public taste today accepts the plain expression of utility as beautiful, whenever that expression is carried out with skill and avoids ungainliness. In step with changing public appreciation, engineers have learned to seek good proportion and to recognize that design calculation does no more than indicate a range of dimensions within which lies well-judged and efficient form. They have learned, too, that the bare minimum of strength does not necessarily yield the most serviceable structure. In last analysis the advance toward beauty of design through effective expression of function has come about through advance in engineering thought itself.

Substantial credit for this is due the pioneer efforts of the American Institute of Steel Construction to cultivate a sense of the esthetic in bridge design. For over a decade its annual competitions have shown progressive rise in the scale of harmony and grace in steel structures, and the 1941 competition, reported two weeks ago, effectively continues this influence. Coming years are sure to see a continuing and indeed increasing demand for beauty in engineering works. The models now being set before us are therefore exceptionally valuable as examples of what must be sought over and above the bare essentials of strength and service efficiency.

Another Cantonment Program

A second cantonment program is nearing the construction stage. It must be carried out with an effectiveness that utilizes the lessons learned during the program just concluding. Preliminary evidence indicates that it will.

Efficiency of construction work is peculiarly susceptible to detailed advance planning and to a minimum of modifications in these plans while work is under way. The original program was adversely affected by lack of attention to both these considerations. Demand for speed resulted in poor site selections, failure to provide access roads, lack of time to adapt standard camp designs to local conditions, the need for cost-plus-fixed-fee contracts and poor timing of material purchasing. That such a super-pressure program would show deficiencies in estimating and in engineering and construction efficiency was inevitable.

The second program will, and should, profit from the lessons of the first. Most obvious was the need for proper advance planning, and this has been under way for months with an adequate technical staff. Sites are being studied thoroughly from every angle. This field work is being paralleled with a careful review of building design, so that the architect-engineer may have the benefit of complete and properly organized data as the basis for his detail camp plan. Such preliminaries, which were impossible in the first program, will allow the call for competitive bids to fix the cost for definite items of work.

As an indication of a more realistic and seasoned estimate of probable costs, the first nine camps for the new program are announced at a figure of twenty-three million dollars each. If unexpected acceleration does not push the program into a scramble that spells low efficiency, it will put to good use the lessons recently learned.

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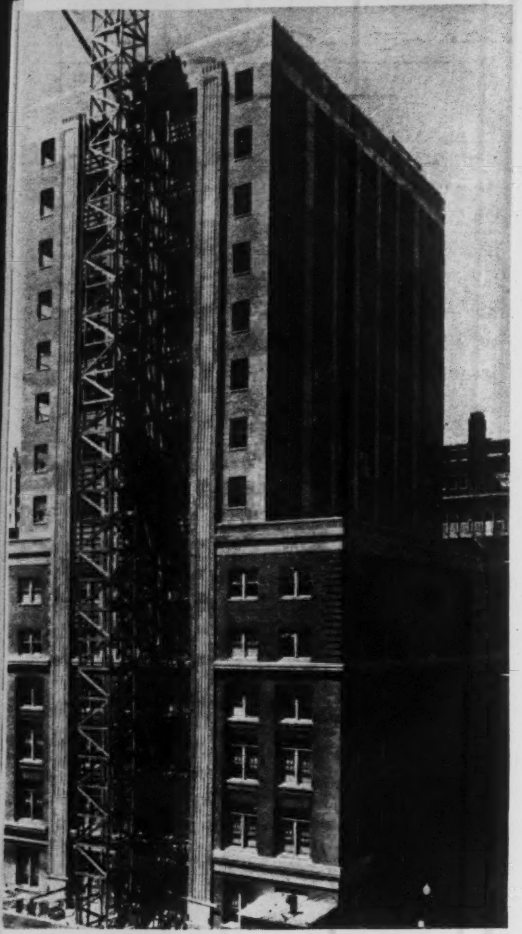


Eight-Story Addition Supported on Six-Story Stilts

Prof. G. A. Maney
Chairman, Dept. of Civil Engineering
Northwestern Technological Institute, Evanston, Ill.

***Contents in Brief**—Eight stories recently added to the six-story reinforced concrete Continental Building in Dallas are carried on new columns, built around the old ones, consisting of four round steel bars and steel plate bracing, resting on enlarged footings.*

The Continental Building in Dallas, Tex., started out as an inconspicuous four-story reinforced-concrete office structure, obtained new life when two stories of steel construction were added later, and finally pierced the city's skyline alongside of neighboring skyscrapers when eight more stories were added. Piling eight stories on top of a six-story structure whose foundations were designed for four presented a neat structural problem. The original footings and the concrete columns in the lower part of the structure were already stressed to safe limits. Furthermore, the owners desired to keep the interior column size down to the minimum, and wanted no new columns installed through the older structure, thus complicating any design of support for the top addition. Lack of space also complicated the design of torsional wind bracing required in the lower floors because of the added eight stories.

The support problem was met by enlarging the old footings and installing independent columns through the six lower floors, consisting of a cage of four round alloy steel bars with collar and plate bracing encircling the original columns. A cantilever truss was built to carry the outside corners of the top addition at the rear of the building, and wind bracing was taken care of in one panel at the seventh floor in the rear of the building, off center in both directions. All operations were carried on with a minimum of inconvenience to the tenants.

New addition on stilts

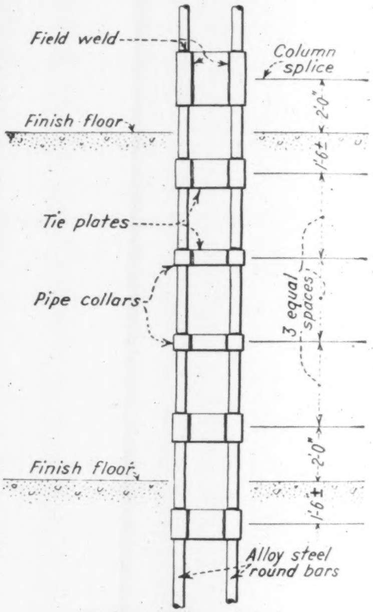
The lightest construction possible, consistent with economy, was designed for the top addition, to keep down the size of the lower columns. A welded structural steel frame with high-strength concrete floors was finally selected as the basic design.

The type of column adopted for support of the new addition through the original structure was worked out by model tests. The four alloy steel round bars, from $3\frac{1}{4}$ to $4\frac{3}{16}$-in. diameter, were welded together with $\frac{1}{2}$-in. tieplates to form a box section around, but independent of, the old columns. The tieplates were welded to pipe collars placed around and welded to the rods. Spacing between ties varied with the floor height.

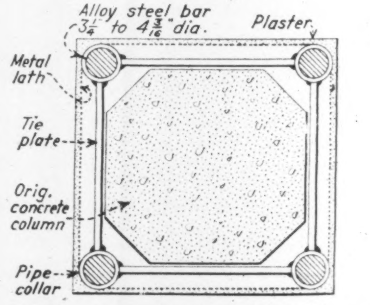
Ends of the round bars were milled for end bearing, and the bars were spliced as butt joints, reinforced by welded pipe sleeves, at alternate floor levels.

After the tieplates had been welded in position, the bars and plates were covered with metal lath and plaster, resulting in a square column only slightly larger than the original octagonal concrete columns. Near the roof line of the old building the bar columns were capped with a heavy plate to carry the steel columns of the new addition. Foundations for the columns consisted of steel grillages set on top of the enlarged original spread footings, which rest on rock

Wind bracing required special

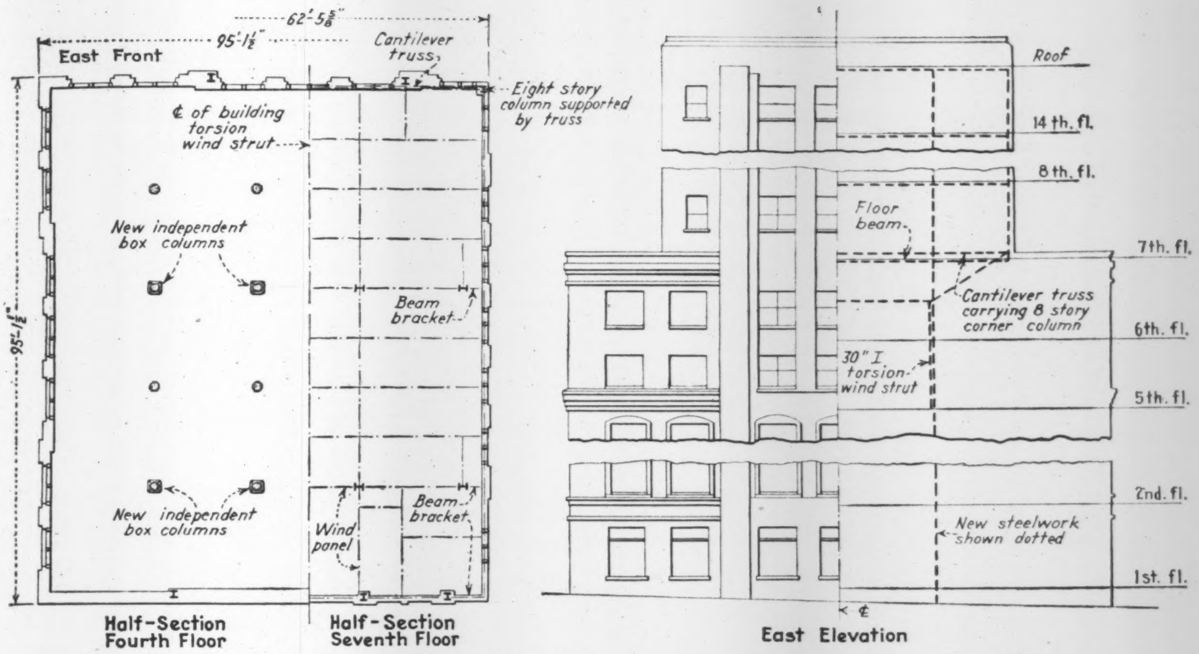


Typical Elevation New Column



Section Through Completed Column

Four alloy steel bars tied together with pipe collars and plates make up the unusual columns.


62'-5⅝"
95'-1½"
East Front
Cantilever truss
Eight story column supported by truss
℄ of building torsion wind strut
New independent box columns
95'-1½"
Beam bracket
New independent box columns
Wind panel
Beam bracket
Half-Section Fourth Floor
Half-Section Seventh Floor
Roof
14 th. fl.
8 th. fl.
Floor beam
7th. fl.
Cantilever truss carrying 8 story corner column
6th. fl.
30" I torsion wind strut
5th. fl.
2nd. fl.
New steelwork shown dotted
1st. fl.
℄
East Elevation

Typical floor plans and east elevations of remodeled building. Note cantilever truss to support 8-story corner column.

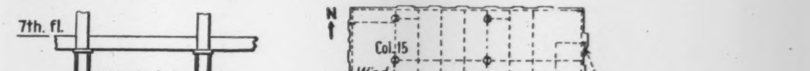
consideration, for the existing tenant arrangements left only two panels toward the west end of the building (off center in both directions) available for this purpose. The location of the panels create a high torsional moment under wind load. Because of the independent columns for carrying the top addition, design for wind pressure had to be considered as that for an eight-story building on six-story stilts.

The wind panels through the old building consist of rolled beams set as horizontal struts between the columns, fastened to the bars by horseshoe clips attached to plates, which, in turn, are riveted to the flanges of the beams. Details are shown in one of accompanying drawings. Diagonal lacing replaced the diaphragms used in the other bar columns to provide additional stiffness.

In the east front, because of foundation conditions, it was necessary to carry the entire east wall of the addition on two structural columns set alongside two of the original concrete columns. These new members were tied to the old columns to prevent buckling but still permit independent settlement. To pick up all the columns in the new section in the east wall, a riveted steel truss was erected in the sixth story, cantilevered 13 ft. out beyond the two supporting columns below to catch the outside corners of the top addition.

Extending from the fifth floor to the bottom of the truss are two 30-in. beam vertical struts, set alongside the new columns. These are rigidly connected to the truss, and are tied in well with the original framework on the east wall. Their purpose is to provide additional resistance to torsion from wind load.

Whitson & Roberts, Dallas, Tex., were architects on the work, and did the job with hired labor. J. B. Beaird Corp., Shreveport, La., fabricated the steel work. The author was consulting engineer.


7th. fl.
Wind girder
6th. fl.
W. G.
5th. fl.
W. G.
4th. fl.
W. G.
3rd. fl.
W. G.
2nd. fl.
W. G.
1st. fl.
W. G.
B'sm't. fl.
Col. 15
Col. 14
Elevation of Wind Bent
N
Col. 15
Wind bents
Col. A
Col. 14
Truss
Torsion struts
Floor Plan
Weld
Col. 15
Wind girder
Col. 14
Fin. floor
Wind girder
Weld
Col. 14
Diagonal bracing on wind panel only

Wind stresses in upper eight floors are carried to the ground through two bents, off center in both directions.

What Priorities Mean to Construction

Robert Colborn
Washington Correspondent
Engineering News-Record

***Contents in Brief**—With increasing rapidity the construction industry is coming to grips with the system of federal control over materials and equipment, set up to assure first things first for defense. A contractor or owner having difficulty getting necessary materials or equipment has several courses open to him. This article tells him what they are.*

PRIORITY REGULATIONS are a symptom of scarcity; they mean that someone has got to go without. Because the construction industry, together with its suppliers, has been better able than most to adapt itself to the demands of the armament program, it has not been affected until recently by priority controls. There is still plenty of construction capacity to meet all needs, and assignment of priority ratings to construction as such are not in prospect.

But in recent months scarcities have begun to develop in many of the materials and tools entering into construction. All the common metals are now subject to some form of priority control, as are several types of construction equipment. And monthly the number of controlled items increases. The contractor and engineer engaged on defense work must be prepared to use the priority system to obtain needed supplies, and the non-defense builder will increasingly find it necessary to resort to more easily procurable substitutes.

In the broadest terms, priority control means the determination of relative degrees of urgency of orders for scarce products. It does not mean that all high priority orders are to be filled first, then orders of lower priority. It does mean, however, that orders with a high priority should be filled when needed—on the scheduled delivery date—even though to do so it is necessary to delay orders with lower or no priority. The degrees of urgency are expressed in terms of "preference ratings" ranging from AA, a rarely used emergency rating, through A-1, A-2, to A-10. The A-1 rating is subdivided: A-l-a, A-l-b . . . A-l-f. It was originally intended to use B, C, etc., ratings, but in practice these have been reserved for urgent non-defense needs.

The present priority system is administered by the Priorities Division of the Office of Production Management, though much of the detailed operation has been turned over by the Priorities Division to a priorities committee in the Army and Navy Munitions Board.

As might be expected of any attempt to govern the synchronization of an entire economy, the priority system is complicated. This inherent complexity is perhaps unnecessarily increased by the piecemeal, trial and error way in which the system has developed. In an effort to hold government regulation to a minimum, OPM has tended to wait until an emergency has developed in some particular commodity and then apply a special set of controls to that. Thus there are vexing detailed differences between the control over aluminum, bulldozers and nickel-steel.

For the construction industry the situation is still further complicated, at least temporarily, by the fact that procedures have been established with an eye to the problems of manufacturing industries, and that heretofore no attention has been paid to the special needs of construction. Any construction firm having much to do with priority-controlled supplies will have to assign someone to keep in touch with the constantly changing details of the system. It is here possible only to describe the several broad types of priority regulation.

The automatic system

Simplest and most commonly used are the "automatic" priorities assigned to certain Army and Navy orders. Foundation of the system is the Priorities Critical List—a list, revised monthly, of items in which scarcities have developed. Whenever a contract is placed by the Army or Navy for an item on the critical list, the procurement officer on his own responsibility may assign a rating to the contract. He finds out what rating to use by reference to a confidential document known as the priorities directive. Subcontracts for materials or parts placed by a contractor having a rated contract may also receive a rating, which would ordinarily be the same as that of the prime contract to which they attach.

Since construction itself is not on the critical list, construction contracts do not themselves carry preference ratings. However, when an Army or Navy construction contractor needs to buy materials or equipment included on the critical list, he can obtain a rating on his order. To do so he need only apply to the procurement officer in charge of his contract, who can himself issue the rating. What the rating is will depend on the importance of the construction operation underway. If the job were building a government-owned airplane factory, the rating might be A-1-d; if it were for a Navy shipyard, it might be A-2. With the exception of a few items such as machine tools it is still true that a rating as low as A-10 will insure reasonably prompt delivery.

In some cases, an Army or Navy contractor may have trouble getting deliveries of some item not on the critical list. Here also a preference rating can be obtained by application to the procurement officer. There will be somewhat more red tape in this case, however, since the application must clear through the Munitions Board and the Priorities Division.

All ratings obtained under this automatic system apply to a particular order for a particular commodity, and separate ratings must be obtained for each order. In some cases where an important project is in constant difficulties with deliveries, a so-called "project rating" can be issued. A project rating applies in one document a particular rating to all orders placed in the course of the project for items on the priorities critical list and for any other items specified in the document. Then when an order is placed by the contractor, it is only necessary to attach a photostat of the project rating to his order.

Technically, there is no way in which a contractor can obtain a project rating on his job, since request for such a rating must originate with the chief of the Army or Navy branch for which the work is being done and must clear through OPM. However, the contractor can of course informally draw the attention of the military representatives with whom he is dealing to the desirability of such a procedure.

Non-military defense jobs

Many contracts which are not placed by the Army or Navy are yet clearly of defense importance. Such contracts might be placed by other agencies of the government—such as a defense housing job—or might be placed by private firms—such as the construction of a power plant or a privately owned munitions factory.

A contractor on work such as this, if he is having difficulty getting deliveries, is also eligible for a preference rating on his orders. However, in this case, he must apply directly to the Priorities Division of OPM. A special form, known as PD-1 is used for such applications and may be obtained from any Federal Reserve bank; it should be filled out very completely and sent to the Director of Priorities at Washington. The form will require that the contractor set forth in detail the nature and defense importance of his work, exactly what the material is on which he is having trouble, what efforts he has already made to get it. A separate application should be made for each major order.

It is desirable, if possible, actually to place the order before applying for a preference rating, even though the delivery date may be unsatisfactory. Then, if a rating is granted, the delivery date can be adjusted. Priorities Division prefers always to grant a rating on an actual existing order. In some cases, of course, suppliers are refusing to take orders unless accompanied by a rating, but OPM is trying to discourage this practice.

Non-defense construction

Builders on work unrelated to defense are going to have an increasingly hard time getting materials—particularly metals—and machinery. The very purpose of priorities is to divert material from this class of work to defense. The case is not always hopeless however. When jobs of major civilian importance—improvement of a municipal water supply, say, or an essential highway job—run into difficulty, the Priorities Division is sometimes willing to help. The help might be assignment of an A-10 rating to the orders which are causing delay, or the division might informally dig up material. There is no set procedure for this sort of situation; it is always handled on a case-by-case basis. The thing for the contractor to do is to write a letter to the Director of Priorities asking for help. The letter should tell in great detail just what the difficulty is, what is needed, when, and how much, and what the importance of the work is.

One other problem involving non-defense construction has not yet received a definitive solution. When a major part but not all of a material is being used for defense, some way has to be worked out to determine which non-defense users will get the part that remains. This is the joint responsibility of Priorities Division and the new Office of Price Administration and Civilian Supply. A tentative procedure has been worked out for aluminum and nickel-steel and this may indicate the approach to be taken in other commodities.

What OPM did was to define a series of B ratings, ranging from B-1 to B-8. The definitions differed for the two materials, but each B rating represented a class of order. Thus uses essential to public health might have one rating, replacement of public service equipment another, expansion of public service equipment still another, etc. Each rating entitled the customer to a certain percentage of his normal use of the material. Obviously, this could not be applied to non-recurring demands such as construction, and the method in general has not proved very practical. In each case it was up to the supplier to decide, on the basis of the definitions, into what B classification a particular order fell. If the customer were not satisfied with his suppliers' decision he could appeal to the Priorities Division.

Some system along these general lines will probably be applied soon to a good many materials.

Industry-wide allocation

When defense needs begin to absorb nearly the entire output of an industry, the above method of applying preference ratings to individual orders is not flexible enough. For this case, the Priorities Division has established a method known as allocation. On this plan, suppliers each month submit their order books to the Priorities Division, which goes over the books, checks that priority orders are getting first treatment, and makes any changes that seem advisable. The division will also direct who shall get any material that is left over. This method is being used for: machine tools, aluminum, magnesium, neoprene, nickel, nickel-steel, tungsten, and zinc. Except in the case of aluminum, nickel-steel, and zinc, suppliers of these commodities have been directed to make deliveries only on orders which have a preference rating. Where, however, the supplier is sure that an order is for defense even though it has no rating, he may arbitrarily assign it a rating of A-10.

Whether or not a commodity is subject to industry-wide allocation is primarily of interest to the suppliers. To the user it means chiefly that he should be sure to get any preference rating to which he may be entitled.

What to do about it

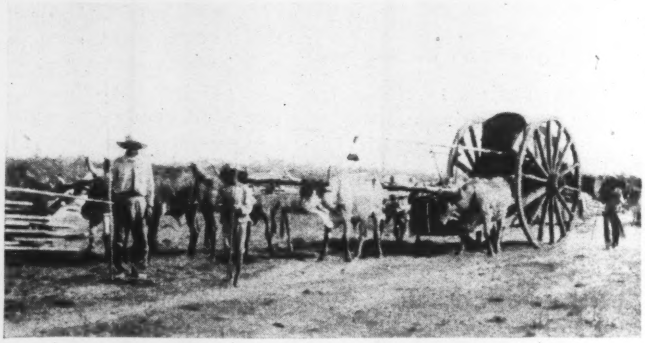
In summary, these are the courses open to a contractor or owner who is having difficulty getting materials or equipment:

If he is building for the Army or Navy he should ask his procurement officer to get him a rating.

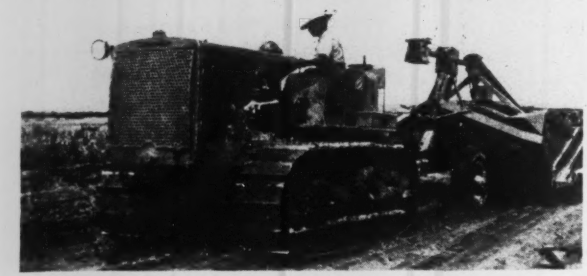
If he is doing defense work not directly for the services he should get a PD-1 application form from his nearest Federal Reserve bank and submit it to the Director of Priorities in Washington.

If he is doing non-defense work he should try to use something else. Failing that, he can write a detailed letter to the Director of Priorities asking for help.

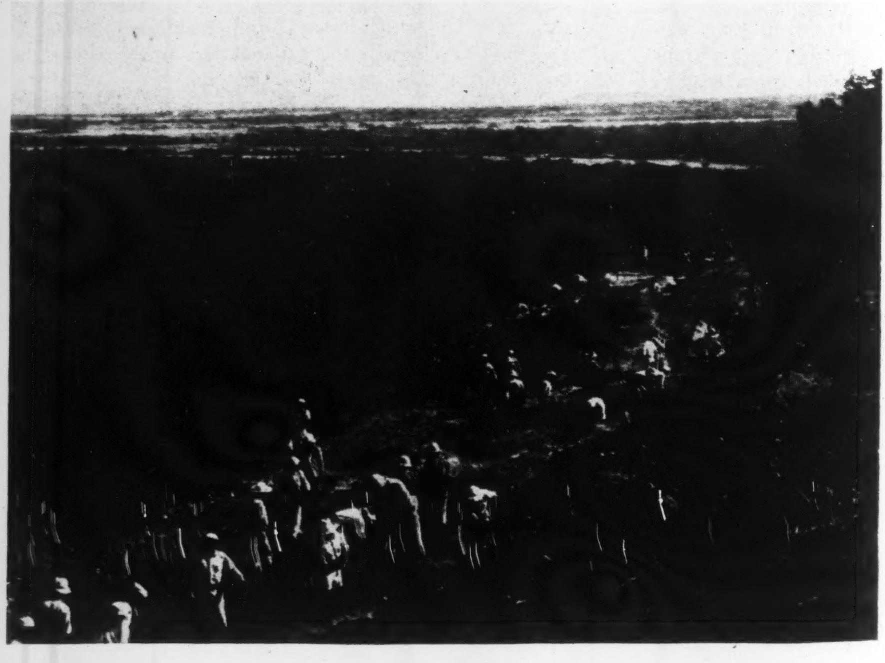
Finished road in the rolling country near the western end of the highway.



Hauling lumber on the old road between Villarrica and Coronel Oviedo. Four oxen are used and high wheels that do not get mired easily.



American construction equipment grading the new road.



Sidehill grading on the line between Ypacarai and Caacupe. In this region the engineers selected a new location with much easier grades and flatter curves than are found on the old road.

Road Construction in Paraguay

Henry Welles Durham
Manager, R. W. Hebard & Co., Asunción, Paraguay, South America

***Contents in Brief**—American engineers and contractors, using American construction equipment, are building the first modern highway to be constructed in Paraguay. This article describes the country through which the new roads are being built, outlines the type of construction that is employed and tells of some of the problems that confront engineeers and contractors.*

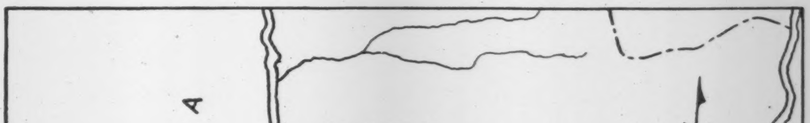
WHATEVER MONUMENT may be erected to the memory of the late President of Paraguay his true and enduring monument will be the "Ruta Mariscal Estigarribia," the first modern highway to be constructed in Paraguay, which the country will owe to the genius and persistence of the President they so tragically lost in an airplane accident last September. Although for many years a highway connecting the capital with the Brazilian frontier had been suggested, it remained for General Estigarribia, when he was Minister from Paraguay to the United States in Washington, to initiate and carry through the work of securing necessary funds to make possible the commencement of this road, which will be the first modern highway in Paraguay. Before leaving Washington to assume the Presidency of Paraguay, General Estigarribia had arranged with President Roosevelt for a loan from the Export-Import Bank of Washington.

The road will serve two purposes. First, it will be part of a main highway crossing the country from west to east. Of this road it is contemplated to build the westerly third now. Second, the portion under immediate construction, passing through the most populous part of the country, is planned to serve as an outlet for agricultural products to the capital, and by means of a branch line between Coronel Oviedo and Villarrica to give to the latter city, the second in population in the country, a motor highway which will enable its traffic to reach Asunción in a few hours. From Asunción there is a road through Argentina to Buenos Aires.

Because road work of this character had never before been undertaken, in Paraguay, the government decided to engage the firm of R. W. Hebard & Co., New York, to plan and supervise the work, that company having carried on similar work over many years in other countries of South and Central America. Preliminary studies were made by the writer in August, 1939, and the contract was signed late in September. Meanwhile, the first party of engineers had been organized in New York so that it could start for Paraguay with its survey equipment and transportation as soon as the contract was approved.

The party arrived in Paraguay late in November and early in December it established headquarters in Ypacarai and surveys were undertaken working westwards to San Lorenzo and eastwards to Caacupe. At the same time investigations were undertaken to determine locations for quarries where rock suitable for road construction was available. Although soft sandstone exists in many places, suitable hard rock is found along the route only in Ypacarai and at two places between Coronel Oviedo and Villarrica. Those are isolated basalt intrusions.

It was necessary to make complete new surveys and plans as the country had not previously been accurately mapped in detail. Although the general course of the route to be followed was indicated by the government, the choice of the exact route depended on thorough studies, in order to secure



The section of road now under construction forms a major link in a highway across Paraguay to the frontier of Brazil.

a location that would give maximum service to the country at a minimum cost.

Old routes followed

The line follows the general course of the old traffic route originally developed by ox drawn carretas and subsequently used by motor vehicles. From Asunción the route to San Lorenzo had been partially improved with asphalt pavement for a distance of 9 km. Between San Lorenzo and Ypacarai, a distance of 25 km., there had been built various concrete bridges but those were poorly located and of an inadequate size for a modern highway. Beyond Ypacarai to Caacupe the road was partially graded several years ago by the use of Bolivian prison labor. Eastward from Caacupe, with the exception of a few wooden bridges, no attempt at road construction had ever been made.

As finally located the new line goes from Caacupe through Eusebio Ayala to San José and Coronel Oviedo, with one short branch to the south. From Coronel Oviedo another branch has been laid out crossing the Tebicuary River and continuing to Villarrica. The total distance from Asunción to Villarrica by road, as surveyed, will be about 185 km.

For the branch from there to Villarrica the route will follow the present cart trail to the Tebicuary River. Here there will be required the most expensive feature of the entire construction, a long bridge sufficiently high to accommodate the flood waters of the river. South of the river the road follows a new location to Villarrica. The total length of this branch will be 45 km.

Between San Lorenzo and Ypacarai the new route is on or near the old line except for a short stretch where it has been possible to use a more direct line to shorten the distance by 2 km. Use is made of the present road east of Ypacarai across the flat marshy plain, but it is necessary to construct new bridges. About 9 km. east of Ypacarai there is encountered a chain of low hills known as the Cordillera, which the old road ascends with a series of sharp turns and steep grades. A better location has been secured along the edge of the valley farther south with a uniform grade of 6 percent to the summit of the Cordillera, about 300 meters above sea level, from which point the line follows a direct route into Caacupe.

Placing and rolling the macadam base. Hard stone for road building is scarce.

Applying the seal coat to the macadam pavement with an asphalt spreader.

Chief problems are climatic

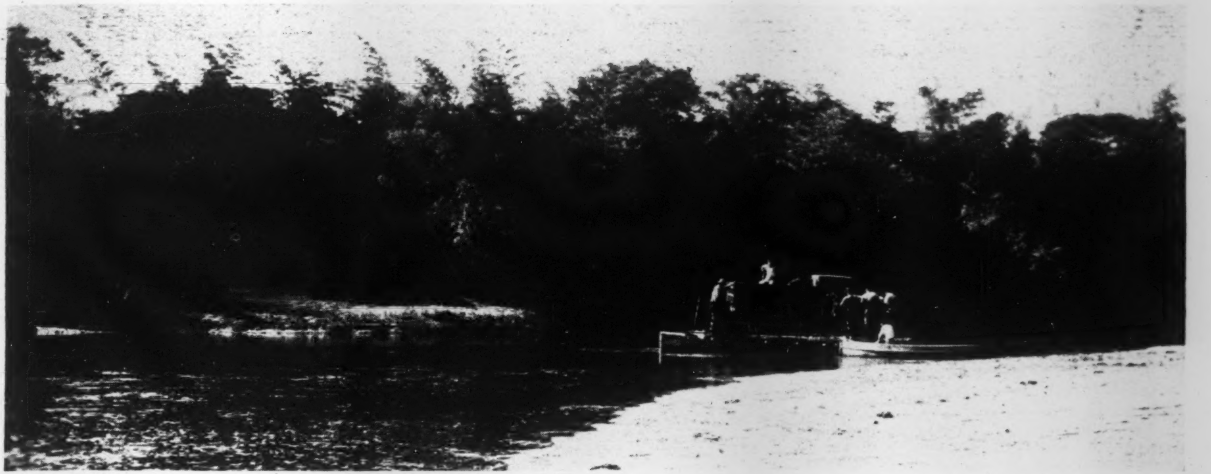
Topographically there is nothing unusual or difficult in the selection of the proposed route. There are serious difficulties in construction which are largely due to the nature of the soil and the climate. Except in the hills, where a soft sandstone exists, the first section of the road as far as Caacupe crosses a series of low elevations separating flat and swampy valleys traversed by meandering streams. In all this region the topsoil is a sandy clay underlying which, at only a few meters' depth, is found an impermeable hard clay material. The result is that for a long period after rain the ground remains saturated. In the easterly section, where the route for some 50 km. is across at flat prairie, the same condition prevails after rain, for the material encountered below the topsoil is a heavy clay. The provision of adequate drainage everywhere is most imperative, and the nature of the soil is such that after rain, mud interferes with the operation of tractor-drawn equipment.

Type of construction

Following are a few details governing construction: Width of right-of-way is 30 meters, width of road, including shoulders, 9 meters in fill, and the width in cut, including ditches, 11 meters. The paved section is 6 meters wide or substantially the same as the usual two-lane 20-ft. highway in the States. The maximum grade, except a few points for a short distance, is 6 percent and the sharpest curves, of which there are only a few, are 6 degrees metric having a radius of 191 meters.

The type of surface adopted for this road is bituminous macadam, consisting of a layer of broken stone of about 6 in. thickness, sand-filled and compressed to form a firm base, on which is placed a 3-in. top course of finer broken stone, penetrated with two applications of asphalt and thoroughly compressed by rolling.

As an alternative to the use of macadam base course there has been adopted, whenever local stone was available, the use of an 8-in. Telford base, hand-placed and rolled. This procedure results in economy through



Ferrying a truck across the Tebicuary River near the site of the proposed highway bridge.

reducing the total amount of long haul trips for the trucks bringing the stone from the quarry, and permits the utilization of the local sandstone frequently found in outcrops along the line, which has not sufficient hardness and resistance to abrasion to permit of its being used for a satisfactory wearing surface, but when protected by a 3-in. bituminous macadam of hard rock constitutes an entirely satisfactory foundation.

Grading and paving

At the end of March grading was practically completed for 70 km. east from the junction with the existing paved road from Asunción to San Lorenzo, and the line had been cleared and fenced for some 10 km. more to the east. The base course has been completed on 45 km. and 20 km. of surfacing has been laid.

Of the 25 bridges to be constructed, excluding the long crossing over the Tebicuary River, four have been completed and eight more are under construction. These are all concrete structures, either reinforced slabs on concrete pile bents or reinforced concrete "T"-beam spans ranging from 5 to 10 meters' clear span, and in the case of the pile structures usually consisting of three spans between the abutments.

In addition to the streams which have to be crossed with bridges there are many smaller water courses and drainage channels for which corrugated iron culverts brought from the United States, with masonry head walls, are employed.

In countries having definite dry and wet seasons the soil conditions encountered in this work would not be difficult to overcome, but in Paraguay rains may be encountered in any month and no definite predictions can be made regarding future weather. During 1940 there was a rainfall more than double the average encountered during the previous 10 years, and in May, 1940, there was more than three times as much rain as in the average for the corresponding month in the previous forty years. Since March nearly half the time has been lost because of rain. Such conditions make construction operations difficult and costly.

The first construction was started at the end of February, 1940, using two companies of labor troops in the vicinity of Ypacarai. It was not until March 1 that the machinery began to arrive from the United States and could be put to work. The largest preliminary undertaking was the preparation of the quarry and the installation of the crushing machinery. Tractors and scrapers for earth excavation started work at the end of March, and during the same period the two companies of sappers were increased to three.

American equipment used

Construction equipment came chiefly from the United States. The quarry is equipped with a large gyratory crusher, a smaller reduction crusher, and screens having a capacity of over 400 cm. per day. The quarry is operated with a 150-hp. diesel engine. Also included are air compressors, jackhammer drills, 24-in.-gage track, steel dump cars and the necessary shops for drill sharpening and repairs.

For the earth grading there are employed eight diesel tractors operating two blade graders, four carrying scrapers, four bulldozers, rooters and sheepsfoot rollers. Surfacing work is handled by eight 10-ton rollers and two asphalt distributors of 1,000-gal. capacity each.

Transportation is handled by a fleet of nearly 80 trucks, including 58 two-yard dump trucks, four six-wheel trucks for heavy duty and numerous light trucks for pick-up and for staff use.

For bridge construction there are three portable concrete mixers and a pile driver.

At the end of March, 1941, there were employed about 3,000 men, including 300 labor troops. The remainder are Paraguayan civilians with the exception of some 20 foreigners, including American and British citizens. Except for the small number of technical and executive personnel that it was necessary to bring from outside the country, the practice has been followed of filling all posts with Paraguayans, including employment of young engineers who are citizens of the country, working under the direction of some half dozen technical men from the United States, who serve in the capacity of resident engineers and superintendents.

Field construction, including organization and training of men who have never been employed on similar work, is under the charge of Mr. G. S. Rinehart, chief engineer. The main office with the work of purchasing and bookkeeping is directed by Mr. P. F. Stratton, comptroller. The writer is manager.

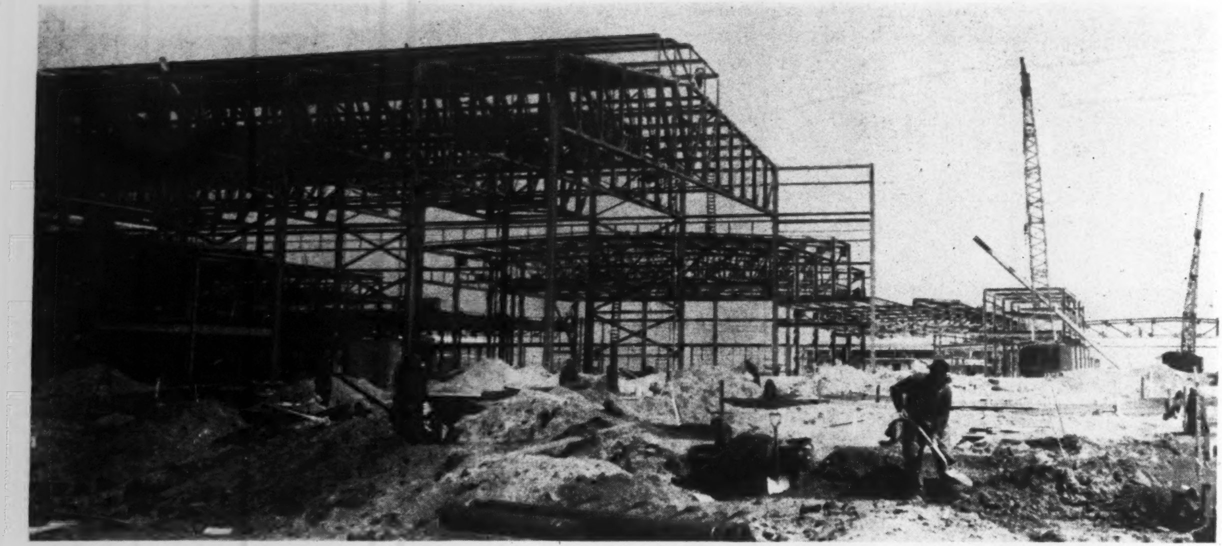


Fig. 1. Erecting the Quonset assembly and repair shop where Navy planes will go for overhaul.

Special Construction at Quonset

Contents in Brief—*The $25,000,000 Naval Air Station at Quonset Point, R. I., involves one of the largest national defense jobs in the country. Every conceivable type of construction is involved, and scarcely any of it was slowed down by the winter weather that complicated operations during the first five months. Procedures were developed that may be useful elsewhere.*

Two Years Ago Last April when Congress passed the famous Pacific airbase bill, under which the Navy was to spend some $70,000,000 at 15 different sites over a three-year period, an item at the bottom of the list got no more than passing notice, even from those who saw it at all. Not only did it involve the smallest appropriation, but the location, although only three miles off the Post Road between New York and Boston, was virtually unknown. The item read: "Quonset Point, R. I., $1,000,000."

What and where is Quonset Point?

But when the first defense bill of July, 1940, added $24,204,000 to the Quonset exchequer, maps were examined and questions asked. Where was Quonset? Why was it being developed? What was the $25,000,000 going to be spent for? Today not only are the answers to these questions at hand, but the work already done has developed a number of procedures important to construction practice. Of particular significance are methods used to cope with winter weather.

Quonset Point is a cape on the west shore of Narragansett Bay. Twenty miles up the bay to the north is Providence; 10 miles down the bay is Newport where the Navy has a training station and its largest torpedo manufacturing facilities. A few miles down the bay is the new Jamestown Bridge to Conanicut Island whose northern tip is directly off-shore from Quonset Point. The Air Station on the Point will be the principal center for repair and operation of the naval aircraft that will defend the northeastern United States, and the huge appropriation is being spent to convert 700 acres of scrub-laden land, 300 reclaimed acres of bay and swamps, and 70 acres on an island off-shore into an aircraft establishment that will be second to none. A brief description of this establishment will serve as a background for the series of construction notes that follow.

When the first million dollars appropriated in 1939 began to be spent in February, 1940, the objective was to build a hangar, warming-up apron and ramp for the seaplanes of the Neutrality Patrol, plus living quarters for officers and men, including a dispensary. The work was let to contract and supervised by the Public Works Officer of Newport as a routine job. Completed last October, this seaplane hangar is now just a minor item over at one corner of a site that is dotted with major construction projects, all under one negotiated fixed-fee contract and supervised by a resident civil engineer officer of the Navy.

Every type of construction

It would be difficult to conceive of a construction job involving more varied types of work than are represented at Quonset. From the control tower of the operations building may be seen railroad sidings, service roads, highways, asphalt runways, great expanses of concrete aprons, four huge hydraulic dredges, seaplane ramp construction inside cofferdams, steel H-section piles for a carrier pier, concrete utility trenches, underground munitions magazines, a power plant, two elevated water tanks, underground water storage tanks, a sewage treatment plant and two colonies of cottages moved from the shore and remodeled for officers and married enlisted men. And dominating these service facilities are the basic buildings of the Air Station—land and seaplane hangars, storehouses, barracks, an administration building, and an enormous assembly and repair shop covering about 6½ acres.

All permanent construction, these buildings encompass both reinforced concrete and structural steel frames with walls of brick, concrete or asbestos-protected corrugated sheet metal siding. With the exception of the Neutrality Patrol hangar, all of this construction is a product of laboring through five months of severe winter weather.

The site

The land purchased for the Quonset Point Air Station was a right triangle with both its base (running east and west) and its hypotenuse (running northwest-southeast) bordering on the bay. To bring it to a square, about 1-1/3 miles on a side, the northeast corner had to be reclaimed from the bay by dredging. Nearly 11,000,000 yd. of hydraulic fill was required, two-thirds of which was pumped between August and Christmas to provide the site for the landplane runways. How this material was pumped in behind a steel sheetpile bulkhead 11,000 ft. long was described in *ENR*, Oct. 24, 1940, p. 546. Some 7,000,000 yd. of additional dredging is required to provide a 35-ft. depth in a ship turning basin 3,000 ft. square and in approach channels to it from the deep waters of the bay.

On the resulting square plot of some 1,000 acres, the structures are laid out in the usual pattern followed for all similar naval air stations. Seaplane facilities occupy the south side waterfront while the landplane runways and hangars are laid out along the east side. In the angle formed by these two layouts lies the industrial area, leaving the northwest quadrant for the officers' quarters, barracks, recreation facilities, dispensary, and administration building.

Road and railroad on peat

For an establishment as large as Quonset, both rail and highway access are of course necessary, and the construction of these facilities was attended by one of the most interesting operations on the project.

Railhead is at Davisville about 3 miles west of the base on the New Haven Railroad, and the rail connection to the base is virtually a tangent for the whole distance. The new access highway runs alongside the railroad for the first 1½ miles from the base, at which point it swings wide (Fig. 2) to provide space for a cloverleaf intersection with the Boston Post Road, which is carried over both rail and highway lines on concrete rigid frame bridges. The Post Road not only marks the halfway point between the base and the railhead, but it is the junction line between two completely different topographies: rock to the west, in which the construction was in cut, swampland and peat bogs to the east, where fill was required. Except for the extreme care required in blasting a ledge of rock, locally famous under the name of "Devil's Foot Rock," that rose to a height of 20 ft. immediately adjacent to the Post Road, rock work was not unusual. It was in placing the fill, 160 ft. wide and as much as 30 ft. high, over the peat that difficulties were met.

Three principal peat deposits were encountered. One was 900 ft. long in which the peat was 25 ft. deep; the others were each about 500 ft. long and 8 to 10 ft. deep. Based on careful cost estimates and some preliminary experimentation, it was decided to blast the deep deposit and excavate the other two.

In removing the peat by blasting, a section of fill about 100 ft. long and some 20 ft. high was first built out over the peat. Pipes were then driven through this fill into the peat and loaded with dynamite. Upon detonation of these charges, the heavy load of the fill confined the energy of the explosion to pushing the peat beyond the edge of the fill, which then settled into the depression thus formed.

Because of the difficulty experienced in driving the pipes through

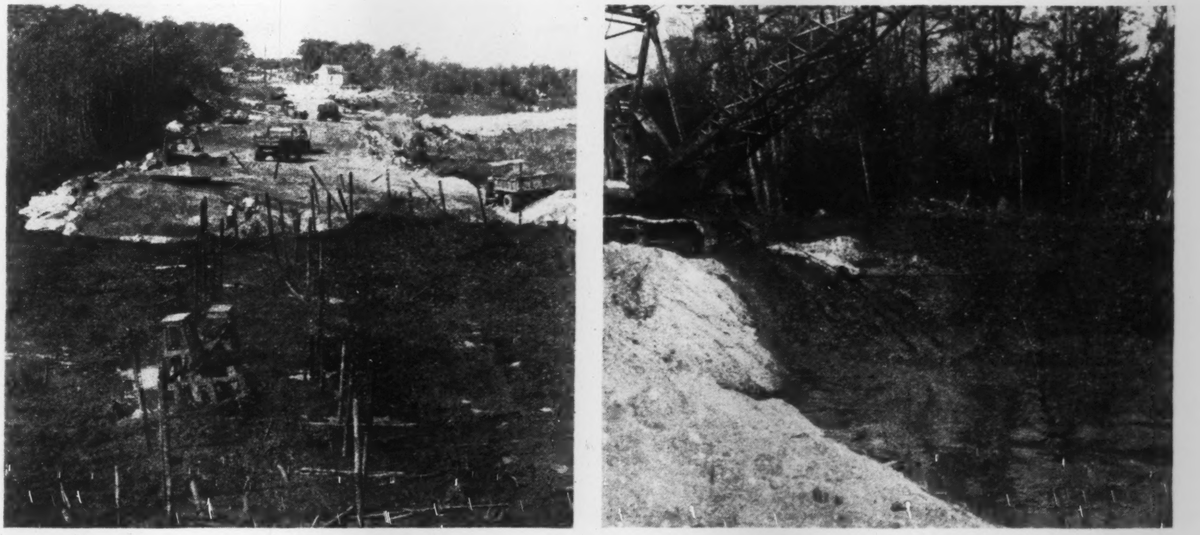


Fig. 2. Two methods of removing peat ahead of highway and railway fill: Left, the blasting method, showing pipes for dynamite charges driven ahead of fill. Right, dragline excavation method.

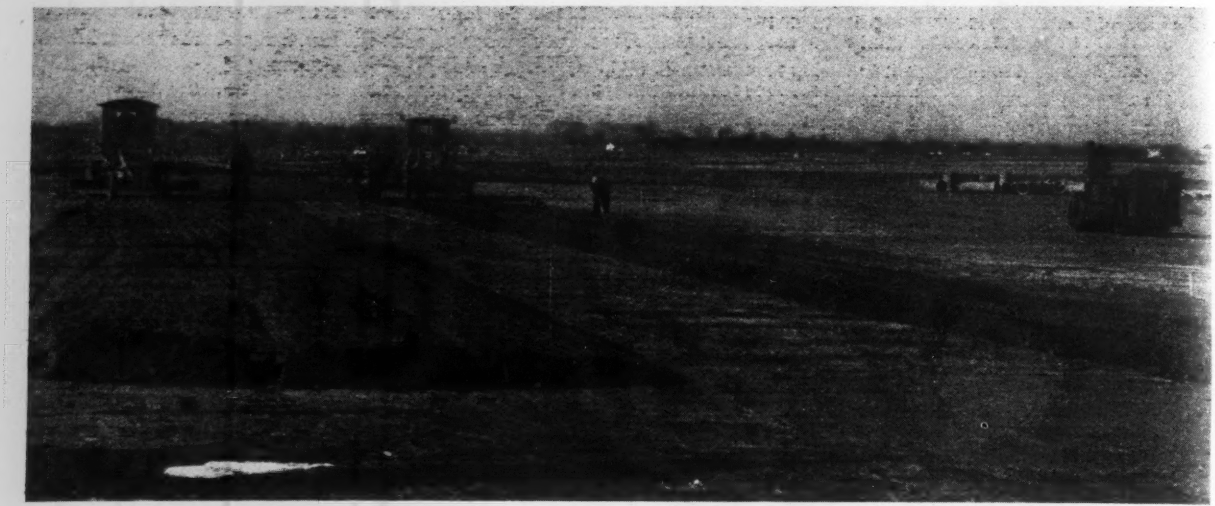


Fig. 3. Runway building on frozen subgrade. Topping of dry clay binder is being spread and rolled as a base for the asphalt surfacing. The mix was brought to the field at a temperature of from 350 to 375 deg.

the fill, however, a change in procedure was inaugurated after the first attempt, by which the pipes were driven into the peat ahead of the fill, Fig. 2 left. Although filling operations displaced some of the pipe, this procedure proved more economical and just as satisfactory. Investigation disclosed that about 80 percent of the peat was removed by this fill-and-blast method.

For the shallower peat deposits draglines (Fig. 2, right) performed the removal operations, casting the peat beyond the limits of the fill area. First operation was to start the fill at the edge of the peat bog, giving the draglines a firm foundation from which to work. Then as fast as the peat was cast aside, the fill was advanced, which tended to push the remaining peat ahead of it.

Because of the different depths of peat involved, fair comparisons between the two methods are difficult to make, although those in charge favored the dragline excavation and sidecasting on two counts. In the first place, a heavy mat of decayed vegetable matter and tree roots on top of the peat had to be broken up before the fill could be placed for blasting, otherwise it would prevent the weight of fill from being an effective surcharge that would confine the dynamite's energy; breaking up this mat was a separate and extra job with the fill-and-blast method, while it was an integral part of the excavation method. Secondly, excavation removed all of the peat while blasting, with the size of charges used, did not effect complete removal; as a consequence some settlement has occurred in the blast-and-fill area. Incidentally, only the highway will have to be raised because of this settlement, since the railroad embankment was cambered some 5 in. over the peat areas and is still above grade.

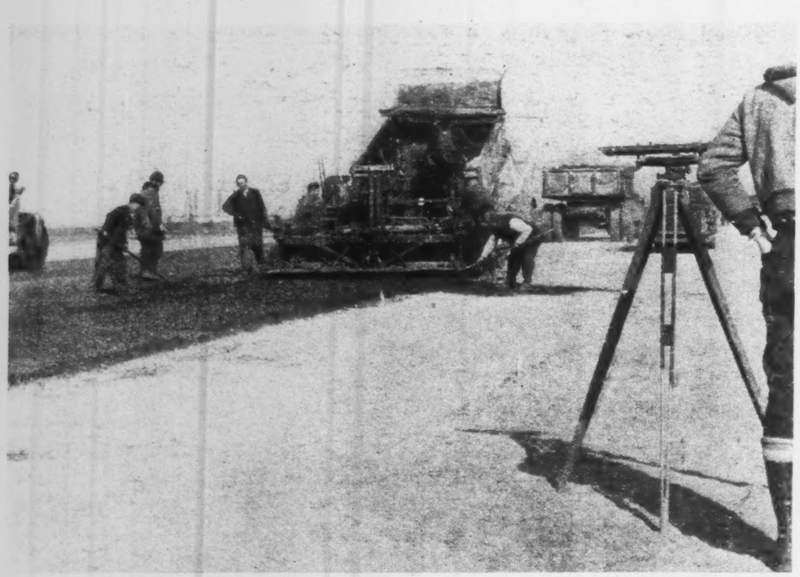


Fig. 4. Paving the runways is virtually a continuous operation. In this view one truck discharges its load into the asphalt paver while another truck waits its turn. Behind the level a tandem roller prepares the next 10-ft. strip of subgrade and at the right another roller brings the asphalt surface to specified smoothness.

Runways in a hurry

The four intersecting runways for the landplanes at Quonset will provide 700,000 sq. yd. of asphaltic concrete pavement. Moreover, this yardage, which arithmetic will demonstrate is equivalent to 40 miles of 30-ft. highway, is 90 percent on recently placed hydraulic fill, a situation which furnished the ingredients for an unusual construction operation. The original plan had been to let the fill settle and drain during the winter months and start paving equipment moving as soon as the frost was out this spring. In December, however, came orders to lay two of the runways to partial width with all speed possible. Engineering planning had to give way to construction expediency.

First necessity was to provide a surface on the frozen fill that could

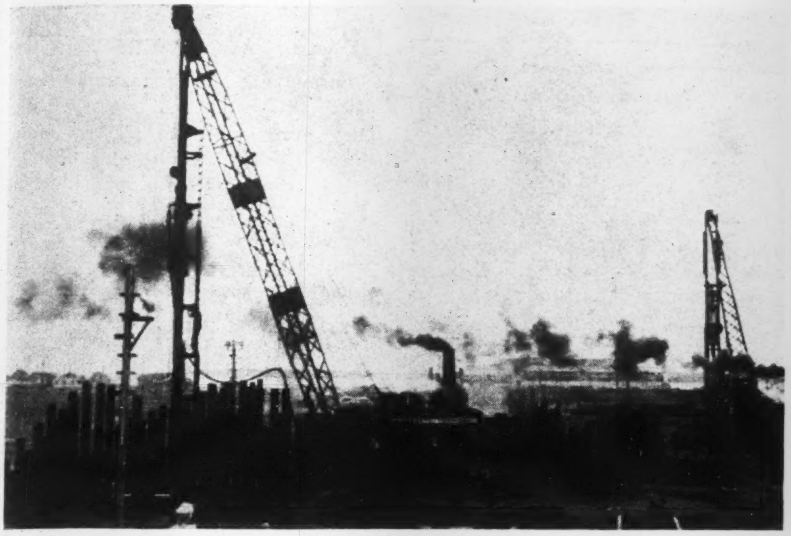


Fig. 5. Tops of piles before cutoff silhouette the uneven rock surface to which the piles for the general warehouse are driven.

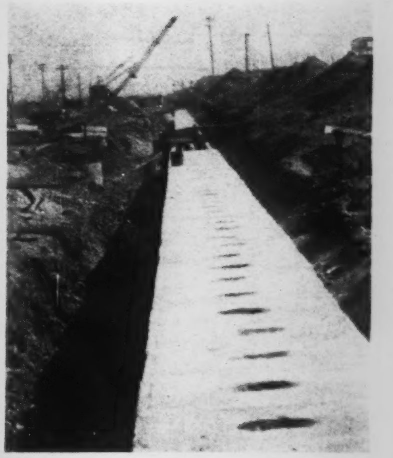


Fig. 6. Slab covers for the utility trenches were made in a central plant at the rate of 150 per 8-hr. shift using vacuum mat forms.

be graded and rolled into a pavement sub-base. This was accomplished with a 3 or 4-in. layer of dry material, rich in clay binder, spread by blade graders and compacted with tandem rollers, Fig. 3. On days when the sun thawed the fill surface into mud, gravel was placed ahead of the clay to take up the water.

On this surface, the pavement was then laid, fine grading and rolling being kept only a short distance ahead of the asphalt spreader, since any thawing created heaving in the sub-base; after the pavement was down, chances could be taken with thawing. The only other precaution was to lay the paving hotter than normal, namely, at 350 to 375 deg., and to cover the hauling trucks with tarpaulins to reduce the heat loss in transit from the 20 deg. permitted by the specifications to only 5 deg. Maximum haul from the plant was about 1 mile.

Operations were carried on with three shifts a day in any kind of weather except rain, and in air temperatures varying from 10 to 40 deg. The arrival of spring revealed no settlement of consequence, and indications are that the runways will not be inferior in any particular.

The winter work furnished experience in job organization and construction technique that is proving valuable in laying the rest of the runways. Pavement is laid in 10-ft. wide strips, 800 to 900 ft. long, (Fig. 4) this being about the length that will still permit a hot bond with the next adjacent strip; complete cooling of the joint requires that it be painted with hot asphalt before the next strip is laid.

Equipment consists of a 100-ton per hr. central asphalt plant, 6 or 7 hauling trucks, two blade graders, two tandem rollers (giving from 210 to 275 lb. per linear inch pressure), and a mechanical asphalt spreader and screed. The only handwork required is to smooth down the ridges formed by the edges of the rollers on the subgrade. With this layout, 4,800 sq. yd. of base course 3½ in. thick is laid in an eight-hour shift. Batches are 2½ cu. yd. made up of 3,120 lb. of screened gravel, evenly divided between ¼-in. and ½-in. stones, 1,600 lb. of sand and 280 lb. of asphalt.

Specifications, which construction must follow, require a base course of not less than 3 in. and a wearing surface of not less than 1½ in. Bitumen in both courses must account for 5 to 7 percent by weight of the mix and shall have a penetration of 120 to 150 (at 77 deg. F. under 100 gr. in 5 seconds). Minimum and maximum mix temperatures are 250 and 350 deg. F., and loss in temperature between the plant and the point of use shall not exceed 20 deg. The lowest possible temperature consistent with good laying is required to be used. The rolling of the base course must produce at least 92 percent of theoretical maximum density. Base course must also be compacted to within ½ in. and the wearing surface to within ¼ in. of established grade when measured by a 10-ft. straight edge.

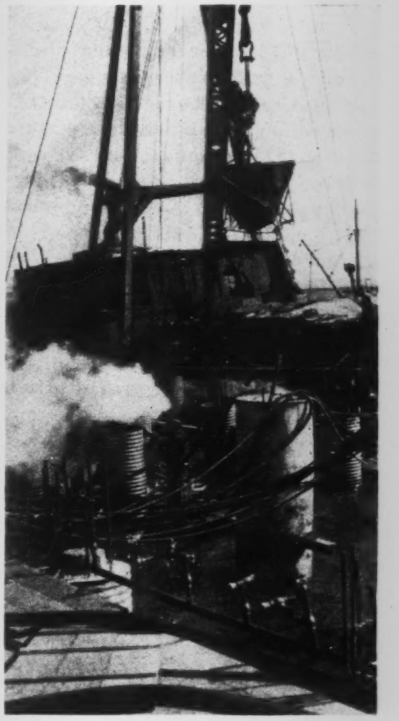
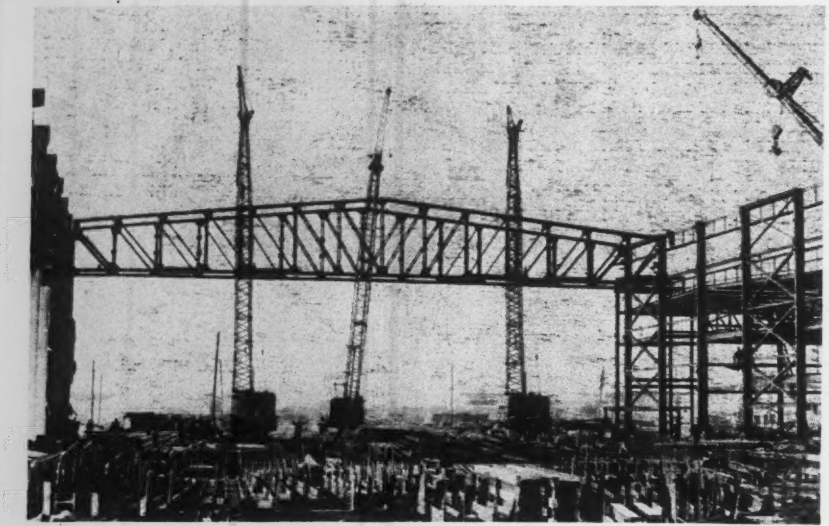


Fig. 7. Concrete incasement of the tops of the steel H-piles for the aircraft carrier pier was placed in corrugated metal forms which were then covered with special steam drums for rapid cold weather curing.

Variable pile penetration

One of the early problems of construction was encountered on the foundation for the general storehouse, a three-story reinforced con-



Pictures Inc.

Fig. 8. Three cranes lift a 15-ton, 163-ft.-span truss into position 75 ft. above the floor of the assembly and repair shop.

crete structure. Here, despite a relatively large number of borings, sub-surface conditions were not as expected and pile penetration even in the same 11-ft. square footing was extremely variable, Fig. 5. Since footings were on 20-ft. centers and each contained 13 piles, the number of pile cutoffs was extremely large and the lengths were quite variable. Fluted tapered steel shells filled with concrete were used, designed for 30 tons each. Despite the taper it was found possible to use the shell cutoffs for lengthening piles that proved too short; or, in combination with new bottom-boot sections, to weld the various length cutoffs into completely new piles.

Vacuum concrete

To speed up setting time and form removal, extensive use was made of vacuum mats on the concrete floor slabs in the barracks, landplane hangars, storehouse, operations and administration buildings. Because most of this concreting was done in winter weather when heating was required, speeding up the set by removing excess water resulted in a substantial economy. Procedure in the landplane hangars, for example, was to apply the vacuum mats to the slab surface for about 20 min. immediately after screeding. The mats were then removed and the slabs covered with burlap plus 6 in. of hay plus a top covering of burlap. Under this protection the concrete surface temperature never dropped below 30 deg. even when air temperature hovered around zero.

Another important use of vacuum concrete was in a casting yard where slab covers (Fig. 6) for the miles of utility trenches were made. Here the speedup possible with the vacuum mats permitted 150 of these 3x4-ft. slabs to be made and removed from the forms in an 8-hr. shift.

Steam-cured concrete

A major structure at the base is a pier extending out into the bay where deep draft ships, including aircraft carriers, can berth. Supports are steel H-piles, and the design called for incasing the tops of these piles in concrete down to 3 ft. below low water. Piledriving was completed early in February, and so as not to delay starting work on the concrete deck slab the pile encasement had to be done in winter weather. Special protection, therefore, had to be provided.

Forms for the encasement consisted of corrugated metal shells. They were supported by two short pieces of railroad rail (Fig. 7) inserted through holes on opposite sides of the shells just above the high water line and welded to the flanges of the piles. By letting the rails project about a foot outside the shells and by installing them with the wide bottom flange up, they can later be used as supports for the deck forms. Another function of the rails is to serve as shear dowels for the concrete encasement, a service in which they are complimentary to steel angles welded to the webs of the piles.

Concrete was mixed in a floating plant with heaters in the mixers, and conveyed to the forms in chutes. High-early-strength cement was used and, as a final precaution, metal drums were lowered over the encasement and fed steam for 72 hr. By maintaining a temperature of 70 deg. for this period the concrete attained a strength of 3,900 lb. per sq. in. as measured by test cylinders broken after 48 hr. As outside air temperatures arose with the approach of spring, the period of steam curing was progressively shortened.

Paving the concrete aprons

A major job of concrete paving is required on the warming-up aprons that serve both the land and seaplane hangars. Total square yardage exceeds 280,000 and pavement thickness is 8 in. Doweled expansion joints divide the aprons into 10x43-ft. sections, and construction procedure was based on placing a 10-ft.-wide strip for the full length of an apron.

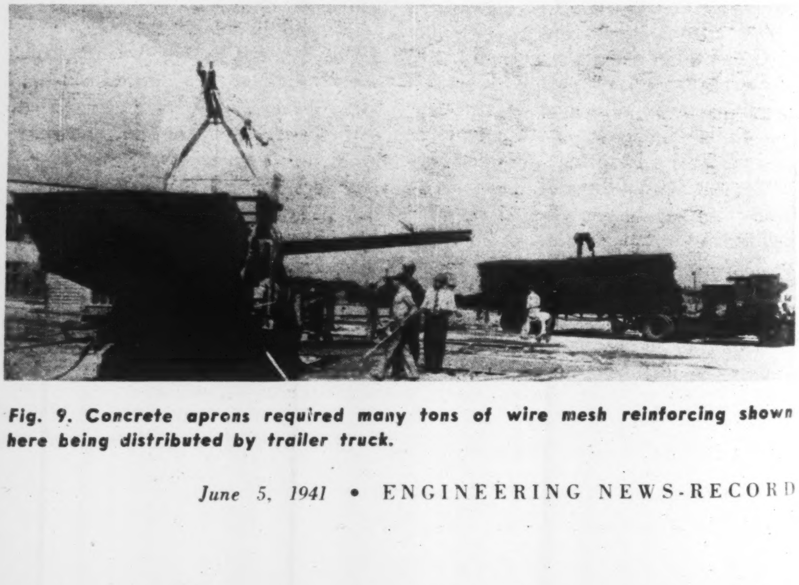


Fig. 9. Concrete aprons required many tons of wire mesh reinforcing shown here being distributed by trailer truck.

Trucks hauling four batches brought material from a nearby central plant to the paving mixers that placed the concrete between steel forms upon which mechanical finishers operated. Steel mesh reinforcement (Fig. 9) was placed near the tops of the slabs and curing was by wetted burlap. None of this apron work was done in winter weather.

Erecting 163-ft.-span trusses

By far the largest building at Quonset is the assembly and repair shop. It is also notable for the diverse types of framing involved, ranging from simple beam-and-girder bays through 100-ft. span trusses to the 163-ft. trusses that span the main assembly aisle. Erection of these latter trusses, of which there are some two dozen, was accomplished without the use of falsework by assembling them on the ground and lifting them into place with three crawler cranes, (Fig. 8). Each truss weighed 15 tons and, since their bottom chords were 75 ft. above the floor, the erection operation was spectacular although, as it worked out, relatively simple.

Handling salamanders safely

Barracks, administration building and bachelor officers' quarters at Quonset have concrete floors and brick veneer walls, all of which had to be constructed during winter weather. The usual tarpaulin inclosure (Fig. 10) and salamander heating was resorted to, but details of the layout were somewhat unusual and very effective.

As soon as the two-story steel frames were erected they were surrounded by scaffolding for the wall masons and inclosed in tarpaulins. At the same time the permanent timber roof was put on, giving complete protection from the icy winds. The salamander heaters were then installed and, for safety and convenience, were suspended from the second floor beams in wood cradles in which the salamanders were so braced that they could not tip over. The bottoms of the salamanders were about 3 ft. above the first floor, a height that placed them out of the way of the workmen and at the same time was convenient for firing.

Spaced on about 10-ft. centers both ways, these salamanders effectively heated the entire building, so that concrete floor slabs could be safely placed. Also, enough heat escaped through wall and door openings to permit the masons to lay up the brick walls without having salamanders on the scaffold with them.

Administration

Building the Quonset Point Naval Air Station is not one single job, but some 56 coordinated projects, each employing its proportionate share of the 11,000 workmen on the payroll. These projects are divided into about 15 divisions, each having a superintendent and staff assigned to it.

The aviation operations building, general store house, aircraft storehouse, and certain other utility buildings were redesigned at the site based on construction drawings previously prepared for use on other projects.

The administration building, cafeteria, dispensary, landplane hangars, barracks, quarters and recreation facilities for officers and enlisted men, as well as the gatehouse and fence, were designed by Albert Kahn Associated Architects and Engineers, Detroit, under the direction of the Bureau of Yards and Docks.

The power plant, utilities and other services were laid out by Gibbs and Hill, Inc., consulting engineers, New York City, working from an office at Quonset Point under the direction of the officer-in-charge of construction. This firm also made the adaptation of the assembly and repair shop design, which was developed by Roberts and Co., consulting engineers, Atlanta, Ga., for similar structures at naval air bases.

Quonset Point Naval Air Station is being built by the George A. Fuller Co. and Merritt-Chapman and Scott Corp. working jointly under a cost-plus-fixed-fee contract with the Bureau of Yards and Docks, Rear Admiral Ben Moreell, chief. Commander Raymond V. Miller (C.E.C.), U. S. Navy, is officer in charge of construction. Commander Miller has several officer assistants, including Lieutenant E. W. Southworth (C.E.C.), U.S.N.R., on design and Lieutenant G. W. Reed (C.E.C.), U.S.N.R., on construction. The key civilians in the Navy organization are J. Duba, senior civil engineer, C. C. McCully, chief draftsman, and B. Barker, chief clerk. E.W. Hammer is project manager, D. H. McGorrisk, assistant project manager, and L. J. Newburg, superintendent in charge of marine work, for the contractors.

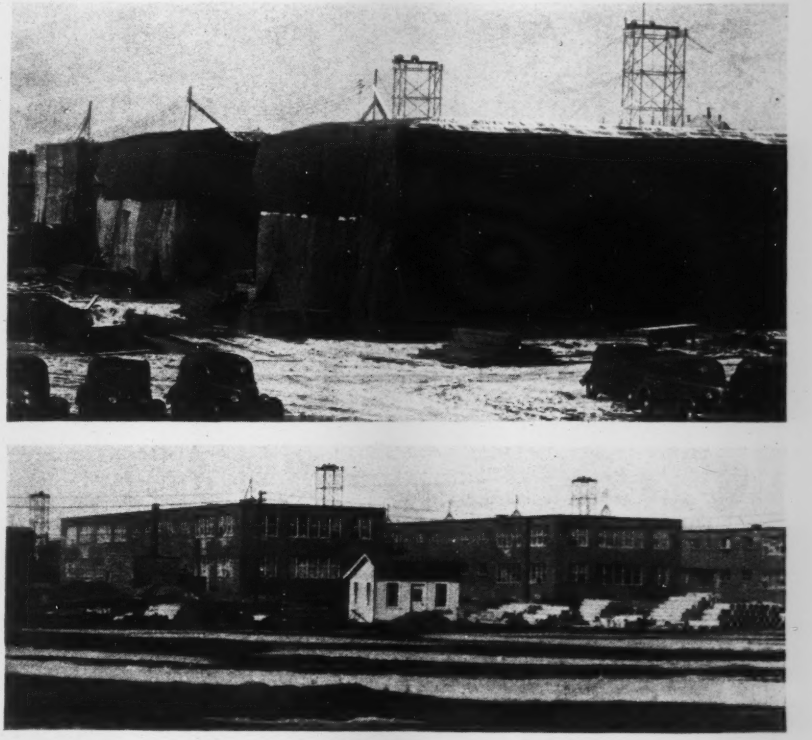
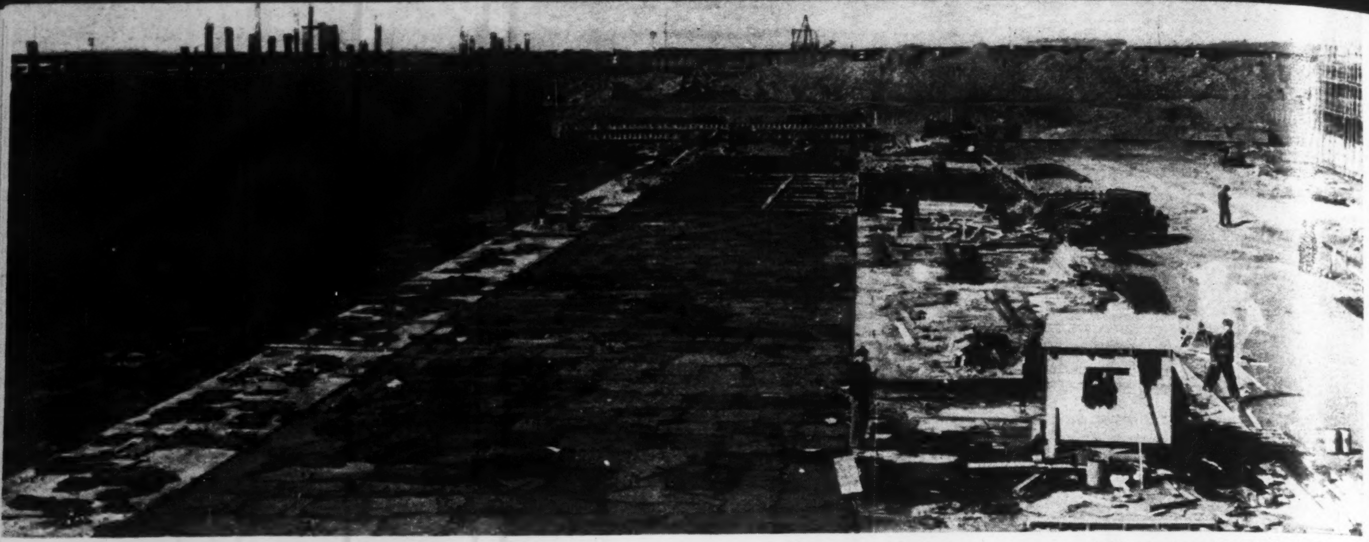


Fig. 10. Complete tarpaulin inclosure permitted barracks construction to proceed through the winter. What was built inside the inclosures is shown in the lower view. Salamanders were suspended from second floor beams.



Portland Press Herald-Express photo

Fig. 1. First basins for construction of cargo boats for Britain approaches keel-laying stage inside rapidly built cofferdam.

Ship Basins Built in Large Cofferdam

***Contents in Brief**—Freighters for Britain will be built in closed basins instead of on the more usual shipways at a new yard in Bath, Maine. The basin area was enclosed in a 1,500-ft. double-wall sheetpile cofferdam to permit construction in the dry. Sheetpile sumps helped dry out material to be excavated. The cofferdam was closed by dropping gates at openings left in cofferdam wall which permitted the tide to run through until all sheetpiling was in place.*

INCLOSURE OF A WORKING AREA for construction of a series of shipbuilding basins at South Portland, Maine, was accomplished by driving a double-wall, rodded, sheet pile cofferdam through a boulder-filled unstable clay, then sand, into an impervious clay stratum. Excavation to plan depth required drainage of the clay and sand to a considerable depth, from soil not believed to be suitable for the use of wellpoints. Small-diameter sheetpile cells were driven at several points in the area, trenches cut to the cells, and slots burned in the piling to permit drainage into the sump for subsequent pumping. This drainage solidified the unwanted material sufficiently to permit hauling over it as well as making it easier to handle.

Thirty freighters, about 10,000 ton dead weight, over 400 ft. long and with a design speed of about 10½ knots, are under contract with first keel laid May 19 and delivery of a completed ship expected by the end of 1941 followed by an additional unit each month, with this time being cut to less than two weeks as construction continues.

The permanent structure

The structure differs from the usual ship construction plant in that it is a series of seven basins side by side, each of which will be about 450 ft. long and 77 ft. wide with a base 7 ft. below mean low tide. These basins are not drydocks in the usually accepted sense as they are not designed to facilitate bringing ships back into them, but have movable gates at the seaward end and sufficient depth to permit floating the completed ships out. They can be built at lower cost than the conventional drydock and have the advantage over shipways of assembly being done with the keel level and no hazard in launching.

Landward end and both sides of the basins are sheetpile dock construc-

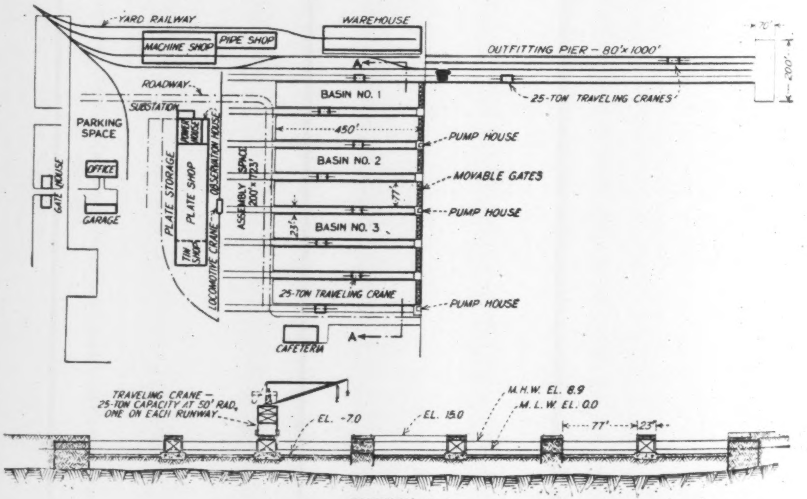

YARD RAILWAY
WAREHOUSE
MACHINE SHOP
PIPE SHOP
OUTFITTING PIER – 80'x 1000'
70'
200'
A
ROADWAY
SUBSTATION
BASIN NO. 1
25-TON TRAVELING CRANES
PARKING SPACE
POWER HOUSE
OBSERVATION HOUSE
450'
PUMP HOUSE
GATE HOUSE
OFFICE
PLATE STORAGE
PLATE SHOP
ASSEMBLY SPACE 200'x 1723'
BASIN NO. 2
MOVABLE GATES
77'
PUMP HOUSE
GARAGE
23'
BASIN NO. 3
TIN SHOP
LOCOMOTIVE CRANE
25-TON TRAVELING CRANE
PUMP HOUSE
CAFETERIA
A
TRAVELING CRANE – 25-TON CAPACITY AT 50' RAD, ONE ON EACH RUNWAY
EL. -7.0
EL. 15.0
M.H.W. EL. 8.9
M.L.W. EL. 0.0
77'
23'
SECTION A-A

Fig. 2. General layout of the permanent structure from a preliminary sketch.

tion with moderate section-modulus steel sheetpiling tied back to a row of wood batterpiles. Two bulkheads are used to divide the seven basins into three areas so that only two or three of the basins will be flooded at one time. The bulkheads between the basins are parallel reinforced-concrete walls, the area between being filled with earth.

Between each of the basins and along the outside of the exterior ones, 25-ton gantry-type revolving cranes will service the shipbuilding area. These are carried on the bulkhead walls, where they are used, the earth-fill material being paved to make a truck runway between the gantry legs. Where no separating bulkhead is used the crane and truck runway are carried on steel bents resting on the basin floor. The floor of the basin is being paved with about 12 in. of moderately reinforced concrete resting directly on the sandy subsoil with heavily reinforced and thickened concrete sections under the keel and craneways.

The present construction includes an 80x1,000-ft. fitting-out pier, with four gantry cranes for completing the work on the ships after they have reached the point at which they can be launched; a 100x550-ft. plate shop with a mold loft above and a plate yard at the rear; a 100x400-ft. machine and pipe shop and a 75x300-ft. warehouse.

Rapid start

Contract for the work was signed on Dec. 23, 1941, and on Dec. 24 actual clearing of the site was under way. Closure across 1,500 ft. of the seaward end of the site was necessary to protect the working area. Boulders, old piling, soft ground, and tidewater varying from 0 to 11 ft. combined to make the cofferdam construction unusually difficult. The top layer of soft material is over a layer of sand which is supported on the impervious clay to ledge rock. It was necessary to drive well into the underlying clay strata to assure a dry working area, this requiring piling ranging in depth from 24 to 40 ft. with the top of the cofferdam about 17 ft. above the ground line, which coincides with the low tide level.

The double row sheetpile type of cofferdam was selected because the depth to solid material required the stability which would be provided by this type structure. The surface clay was expected to make a satisfactory and impervious cofferdam fill.

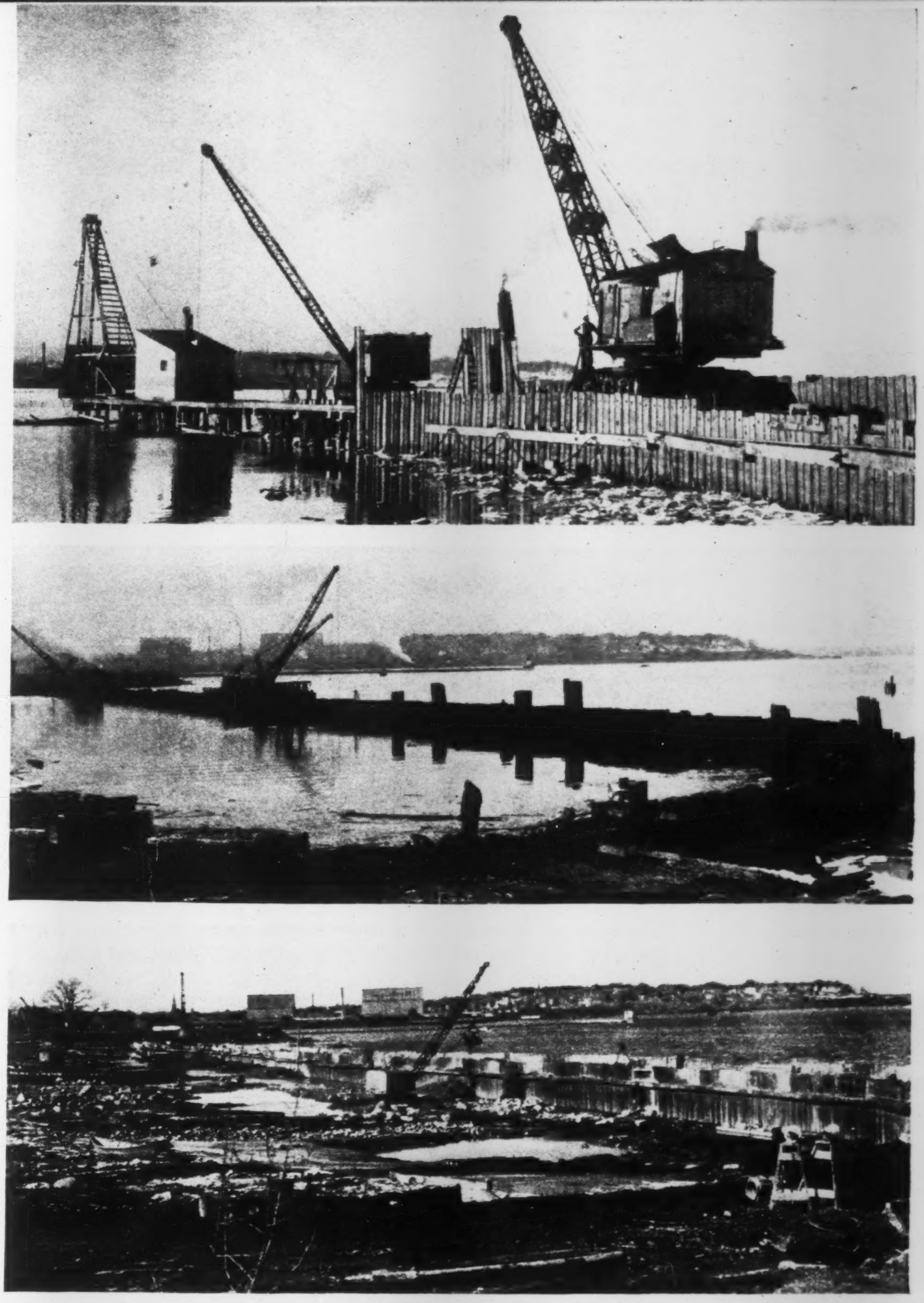


Fig. 3. (Top) Special driver at left put down piles for trestle bents 14 ft. ahead of driver, followed by gas crane setting sheetpiling and big steamer driving. (Center) Cofferdam nearly completed with improvised gates open to permit tidal flow. (Below) Cofferdam started on Jan. 15 looked like this on Feb. 16.

The cofferdam was constructed by first driving wood-pile bents to support the driving equipment and the cofferdam sheetpiling. Five pile bents of untreated timber were driven to moderate resistance and capped with 12x12-in. timbers 16 ft. long, which carried runners along the outer ends (Fig. 3) to make a driving templet for the sheetpiling. The bents were spaced 14 ft., 14 ft. and 5 ft. apart. Two 32-ft.-long steel beam assemblies, designed to support heavy construction cranes, rest on the bents with ends butt-joined at the 5-ft. space. The pile bents were driven with a special long skid rig with the hoist and boiler set well back to balance driving 14 ft. ahead of the support. Following this outfit a gas-powered crane, using a jib when required, set the $\frac{1}{2}$-in.-thick, shallow web, steel piling and was followed by a steam crawler crane, which did the driving with a medium-size double-acting hammer. Rods, $1\frac{3}{4}$ in.

in diameter, with ends upset to 2 in., tie the cofferdam near the top at about each eighth pile.

Piling and supplies were brought to the cofferdam by special rigs with long skids for dragging over a rough bottom. They had buoyancy drums of empty barrels, set up inside the skids away from exposure to rocks, etc., to handle material when the tide was high, thus making material available at any tide stage.

Special tide gate

During closure of the cofferdam ebb and flow of tide could be expected to cause troublesome velocities in the working area so five ingenious but inexpensive "gates" were cut out of the sheetpile walls of the cofferdam. A spot for a gate was selected between wood-pile bents 14 ft. apart where the ground was reasonably firm and near low tide level. Inside the cofferdam walls, 4-in. plank was placed just outside the piles of the adjacent bents to keep fill material out of the gate area. Next 6x6x½-in. angles were welded to eight pieces of piling between the bents just above the ground and the one wall in both lines of sheetpiling.

The eight piles were then cut off just above the ground but below the welded-on angle and the gate lifted by a crane, using interlocks of the piling as gate guides and watertight gate slots. Five gates were provided, held in the open position by posts set under the top angles as shown in Fig. 3, center. Maximum velocity of flow through the gates was about 2 mph., as much as 3-ft. variation in sill depth being permissible as the area underwater decreased rapidly as the tide ebbed, thus requiring less opening area at lower water level.

Marine clay for cofferdam fill was handled into place by crawler draglines operating inside the enclosure at low tide and by barge-mounted cranes outside the coffer at high tide. After driving was completed the cranes working on the cofferdam assisted with the filling, traveling on the work runway.

As the ground surface was at about low-tide level, unwatering was accomplished by the simple expedient of dropping the improvised gates at extreme low tide and placing special wales at the bottom to hold the outward thrust of the quickly placed fill behind the gates. Small, low areas required minor pumping.

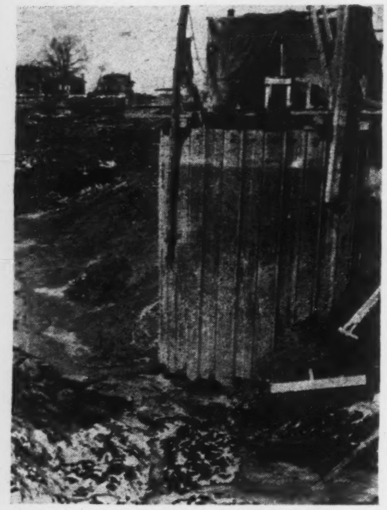


Fig. 4. Circular sheetpile cofferdam, excavated below foundation level and slotted, provides drain and sump to dispose of ground and surface water. Additional slots are just beneath the surface.

The unstable clay underlying the basin area becomes moderately solid when somewhat dried out. However, the material was quite impervious and the constructors did not believe that wellpoints would drain the area.

Sheetpile shafts, of the smallest diameter conveniently made into a circle, were driven well below the projected excavation level and slots cut in the sheets as shown in Fig. 4. Centrifugal pumps were installed for drainage. First pass of the excavation was a dragline-cut to just below the series of slots that may be seen in the sheetpiles. Attempts to dig deeper were fruitless as muck flowed into the trench but after this depth cut had permitted drainage into the shaft for a few days, the upper material dried out to the consistency of a sandy clay capable of supporting excavation equipment and which could be easily loaded by shovel and dragline for truck haul. It was necessary to gravel the hauling roads in the cofferdam, material for this coming from waste ship ballast. After some drying had stabilized the upper layers of material it was possible to dig the trenches somewhat below final excavation area to drain the material, especially the sand.

Excavation was handled with draglines and shovels of whatever sizes were quickly available. Hauling was done by three to five yard trucks working on an hourly rental basis. Very little rock was encountered and this was removed by the customary shallow drilling and blasting.

Disposal of unstable and unwanted muck in a residential area created a problem of long haul and piecemeal disposition. Abandoned gravel pits took part of the material, but required special traffic deputies at every intersection to expedite hauling and prevent accidents. A marsh section of the bay permitted disposal of a large quantity which was dumped on a chute and sluiced out. Finally, part of the material was loaded on barges and towed to sea for disposal.

Concrete for the work is being obtained from commercial plants in the vicinity, delivering in truck-mounted mixers, and from a specially erected batcher for truck mixer charging, erected at the site of the work. Aggregates are trucked to the newly erected plant and put into the bins by a belt conveyor.

No rail connection to the site existed and none is contemplated as limited space available makes it necessary to store most material elsewhere. A plate storage yard has been built at a rail connection about 2 miles from the basins with more than 4,000 ft. of track installed for rail delivery of plate. Trucks haul the plate to the plant.

Management

The ships are being built by the Todd-Bath Iron Shipbuilding Corp., W. S. Newell, president, for whom Gibbs & Cox, naval architects of New York, are consultants. The British government is represented on these contracts by the British Merchant Shipbuilding Mission, the resident members of which are Messrs. Wm. Bennett, H. Hunter and R. R. Powell. At South Portland, J. S. Ormiston is in charge for Lloyds Register of Shipping, assisted by A. Hunter.

The basins were designed by Chas. T. Main, Inc., engineers, of Boston, for whom Julian H. White is in charge in the field.

Working under an agreement similar to that of the U. S. Government's cost-plus-fixed-fee contracts the Sanders Engineering Co., of Portland, Me., is doing the construction of the basins. During building of the cofferdam and excavation A. C. Stanley, was in charge of the project, John Sweeney was general superintendent, and L. R. Small, outside superintendent.

Highlights Reflecting Canadian Waterworks Practice

M. N. Baker

Associate Editor (Retired)
Engineering News-Record

Filter gallery in Toronto's new plant.

THREE WIDELY DIFFERENT TYPES of large water filtration plants—not to be found side by side elsewhere in the world—will be open to inspection by those attending the annual meeting of the American Water Works Association at Toronto, Canada, June 22–26. They are the slow sand, drifting sand and typical rapid sand filters, located on Toronto Island, in Lake Ontario. The slow sand filters were completed in 1911; the drifting sand, in 1916; and the latest plant, some months ago. Because of war conditions the new plant has not yet been put into operation.

The slow sand filters, designed by Allen Hazen, were among the large plants of their kind built this side of the Atlantic. Hardly were they completed when a larger supply was needed. At this time a demonstration plant of a new type of filters was patented in England and installed on a small scale at Merthyr Tydfil, Wales; it gave results that were satisfactory to the local authorities, and a contract for a large permanent plant was let to a company promoting drifting sand filters in Canada. William Gore, one of the patentees, and William Storrie, were consulting and chief engineers for the contractor. Then, as now, R. C. Harris was commissioner of works of Toronto.

The distinguishing feature of these filters is that they are washed by ejecting the filter sand from an inverted conical bottom through a number of small pipes. The sand is carried to the top of the bed and falls in showers or drifts. The dirty water is wasted from above the beds.

The Toronto drifting sand filters were soon followed by similar ones at Brampton, Oshawa and Rockland, Ont., all of which have been abandoned. Also abandoned was a similar filter at Jamaica, British West Indies. At latest accounts drifting sand filters were in use at Pernambuco (Recife), Brazil, as also the initial plant in Wales.

Although the drifting sand filters at Toronto are said to have given satisfaction (after the substitution of larger sand-ejecting pipe), typical rapid filters were adopted for the third set of filters.

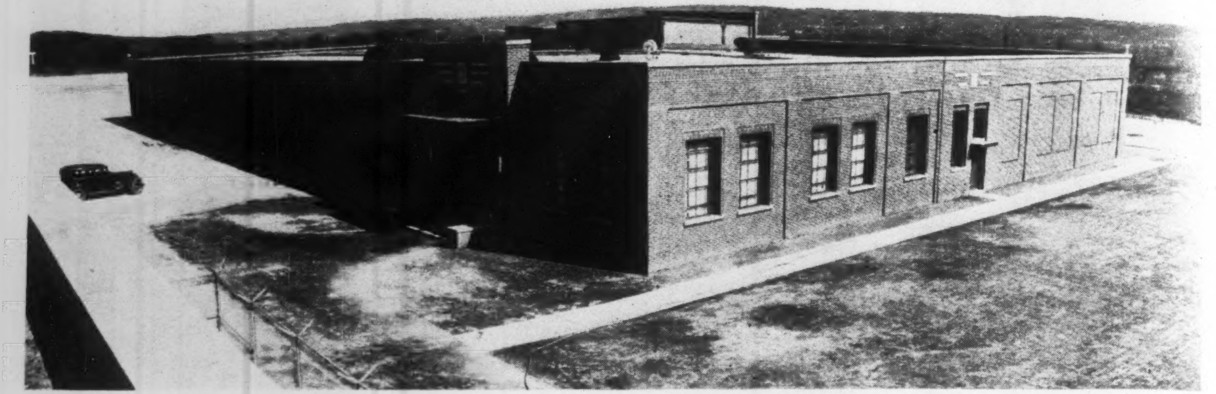
Throughout Ontario and the other Canadian provinces but few waterworks attempted purification until rapid filtration practice had displaced slow sand filters. By the close of 1900, of the dozen cities for which filters had been built in Canada, the only one to install a slow sand filter was Victoria, B. C. First among Canadian cities to put in mechanical filters was Winnipeg, Manitoba, where a small National filter went into use in December, 1887. Water was pumped from the Assiniboine River through the filter directly to the consumers.

It is of interest to report that a large percentage of the rapid filters now in use in Canada are of the pressure or pumping-through type, according to data gathered by A. E. Berry, secretary, Canadian Section, American Water Works Association. Winnipeg is credited with being the first city in North America to have a water softening plant. It was put into use July 1, 1901, following a recommendation made in 1898 by Rudolph Hering that the city abandon the river supply for artesian wells.

More notable among much earlier ventures in the quest for pure water in Canada than any yet mentioned were the infiltration basins at Hamilton and at Toronto, Ont. Hamilton was the first city on record in the Western Hemisphere to adopt "natural" contrasted with "artificial" filtration. In 1859 it began taking water from a large open basin on Burlington Beach, adjacent to Lake Ontario. The works were designed by Thomas C. Keefer, Canadian-born and educated engineer.

This basin was long the sole water supply of Hamilton. It was not abandoned until 1928 but meanwhile its yield had been supplemented by enlargements and by taking water directly from the lake. At Toronto an infiltration basin adjacent to Lake Ontario was built as part of new works constructed in 1875–78, Keefer being one of a board of consulting engineers. This basin was short-lived. For decades Toronto was supplied with untreated lake water. Chlorination was begun in 1910. In 1912 began the sequence of slow sand, drifting sand and typical rapid filters already noted.

(The slow sand filters at Toronto were described in *Engineering News*, Mar. 9, 1911, p. 302, and an account of the drifting sand filters is in the issue of Sept. 21, 1916, p. 366).



Windows are confined to the office section of the mirror plant. Penthouse on roof contains the heating, ventilating, and air conditioning equipment. Main air feed duct leads from penthouse across roof to distribution ducts in ceiling.

FACTORIES FOR DEFENSE

Army Engineers Build a Mirror Plant

Contents in Brief—*With construction started four days after the design section was notified to proceed with detailed plans, the Cincinnati, Ohio, U. S. Engineer District recently designed and built in 157 days a 263x124-ft. one-story plant for the manufacture of searchlight mirrors. Because of delays in materials deliveries, exterior walls were started before steel erection; a gap left in the walls permitted the removal of steel erecting crane.*

To PERMIT MANUFACTURE of metal searchlight reflectors by an electrodeposit method, a $300,000 plant equipped with $300,000 worth of machinery was recently designed and built at Mariemont, Ohio, in 157 days by the Cincinnati, Ohio, U. S. Engineer District for the Engineer Board of the Corps of Engineers. Only preliminary work was an estimate of the building's cost and preparation of a general floor plan and architect's rendering. General requirements were to build a one-story structure with dimensions of 260x120 ft. and 16-ft. vertical clearance over a 200x80-ft. basement of 6½-ft. clearance, and then to construct a detached powerhouse and caretaker's quarters. The main building was to have forced-draft ventilation, air conditioning with accurately controlled temperatures, and artificial lighting. A major portion of the structure was to be occupied by 83 electroplating tanks 5x7 ft. and 8 or 9 ft. deep, resting on the basement slab and projecting a short distance above the ground floor.

Notified on a Friday that a site had been purchased and a contractor selected on a cost-plus-fixed-fee basis to start excavation the following Tuesday, the design section started its hurried program. First decision was to make the main building's exterior walls of bearing type, 12 in. thick and of brick with cinder-block backing. Interior roof supports were to be of steel.

Plans ready in 4 days

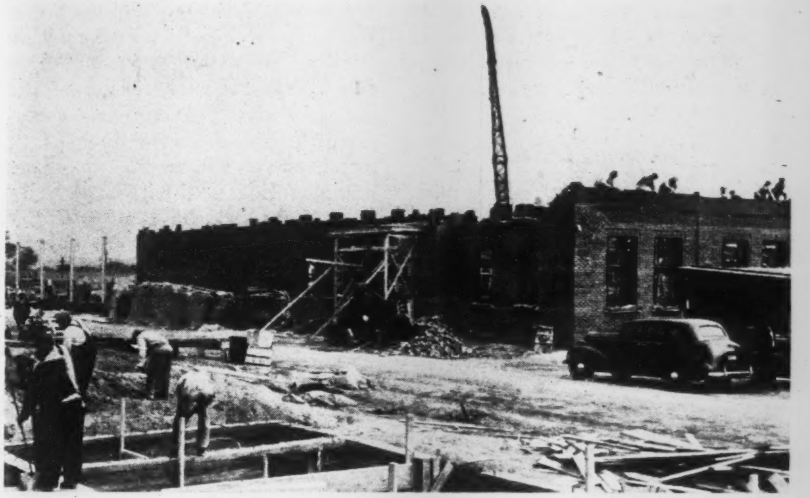
Despite a Sunday and holiday in the four-day interval, necessary excavation and foundation plans were available on Tuesday. From then on the construction drawings and plans were made first that were needed most. These were taken directly from the drawing boards to the field without time being spent for reproductions. In less than a month the major part of the architectural drawings were furnished the contractor.

The general structural plan decided upon required 8-in. 24-lb. wide flange section on 20-ft. centers each way as columns, supporting 12-in. 36-lb. beams running crosswise of the building. To these are framed 10-in. 21-lb. beams running lengthwise of the building on 6-ft. 8-in. centers as purlins to carry a built-up tar and gravel roof on a metal deck. Windowless walls are used except for the offices near the front. Reinforced-concrete floors are used throughout. The design and general drawings for all mechanical and electrical work were made as fast as design data were furnished by the Engineer Board; and in order to expediate construction, the details were worked out on the job by the field supervisors.

As a further aid in speeding up construction a railroad siding required for the plant was immediately placed under construction and completed within three weeks. This made possible easy delivery of materials and equipment.

Walls started early

Major problem for the contractor was to prevent delays because of lack of materials. The solution after constructing the foundations, was to start the exterior walls without waiting for steel deliveries. As a result, when steel arrived six weeks after ground was broken, the basement, all foundation walls, and about one-half of the exterior walls were complete. Steel erection proceeded with crawler crane, and by the time the job was finished, in less than two weeks, the outside walls were complete, with the exception of about one-half of one end including a gap to permit the crane to back out. The entire building was inclosed after ten weeks of work, and the next day all trades started interior work and installation of equipment. The Engineer Board took over the plant on Feb. 3, 1941, 153 days after construction began or 157 days after preparation of detailed plans started.



Exterior walls of brick with cinder-block backing are built while 10-ton crane with a 50-ft. boom erects steel on the inside.

Building air conditioned

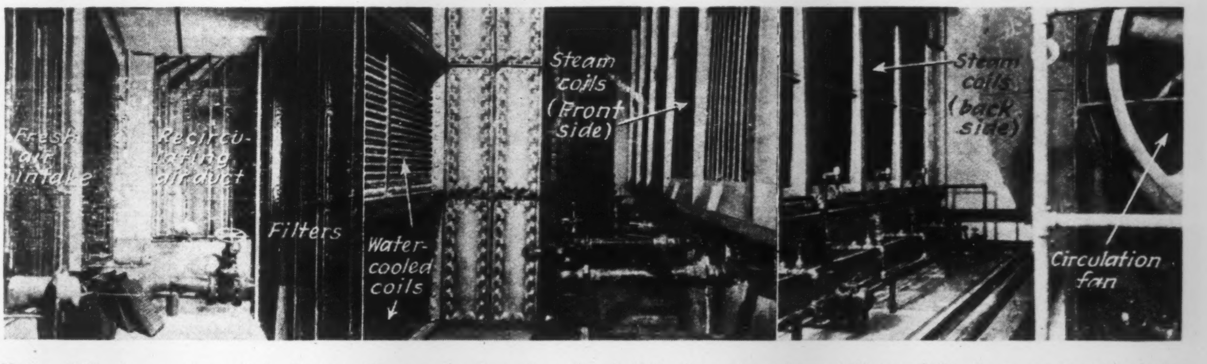
Being of the windowless type the building required air conditioning throughout. A well was drilled to provide an abundant supply of well water of a temperature sufficiently low to extract moisture as well as heat from the air as it was passing through the cooling coils. This is very important since the moisture content of the air is high due to the evaporation load from the electroplating tanks.

Two systems of air conditioning are used for the main building, one for the office and one for the factory, and each system has two zones in order to control properly the different exposures. The systems are automatically actuated by thermostats in each zone, and the office system has a humidistat in the return air duct to control the humidifier in the winter time. Maximum daily load on the factory system in the summer is estimated as 210 tons and on the office system 14 tons. For both systems 450 gal. of water per min. are required. The water is supplied to the coils at 55 deg. and is wasted at about 67 deg. F. Spraying the water on the roof after it passes through the coils will make possible a saving of about 20 tons per day in the air conditioning load.

Air for the factory system, 70,000 cu. ft. per minute, consists of 25 percent outside air and 75 percent recirculated air. This mix is drawn through the filter, the cooling coils, the heating coils, and then into the blower system as illustrated below. The main supply duct is on the roof, as shown on the opposite page, and the air is distributed through branch ducts located between the crane rails just below the roof.

The electroplating tanks resting on concrete footings on the basement floor give off considerable heat to the basement air. In order to overcome this condition, the basement is air conditioned by drawing air from the main tank room through stair wells at three corners by means of a 15,000-c.f.m. fan. This air in turn is wasted through an outlet on the roof or is discharged into a paint spray room. The spray booths require 20,000 cu. ft. per minute, and are kept at a lower pressure than the rest of the factory. Because the shops along the southern side of the plant require more heat during the winter than the tank room making up the major part of the factory area, a heating booster coil controlled by a separate thermostat is required for these shops.

In the office system the recirculated air and outside air are drawn through the filters into the fan. Here the heating coils are directly above the cooling coils with a metal partition between them. The coils run wild and the temperature is controlled by interlocked proportioning dampers in the hot and cold decks. As there is no basement under the offices, the return air is carried away through vitrified clay pipes under the floor.



Air conditioning equipment in the penthouse. Fresh and recirculated air passes from left to right. In summer well water is pumped through the cooling coils, while in winter air is warmed by heating coils. Either one or both coils can be shut off; with both idle, air system is used for ventilation only.

The main working areas of the plant and the offices are illuminated by fluorescent light. Incandescent units are used in the basement, storage areas, and hallways. .

Bottleneck broken

Before the Mariemont mirror plant was put into operation, the limited production of metal reflectors was causing a bottleneck in army searchlights. The Army's only plant making the reflectors was at Ft. Belvoir, Va., near Washington, and the Sperry Gyroscope Co. and the General Electric Co. were building searchlights faster than reflectors could be produced. Today the picture is reversed, for it is now possible to make the metal reflectors faster than the drums and mountings of the lights.

Lt. Col. Fred T. Bass is district engineer at Cincinnati. For the mirror plant Paul A. Harper, associate engineer, was in charge of construction and acted as project engineer. W. K. Shilling, Jr., associate architect, at first was in charge of design but with his temporary transfer to the Nashville office, L. P. Thompson, junior engineer, took over this part of the work. Thos. Scalise, asst. engineer, was in charge of all mechanical installations and W. B. Riner, asst. engineer, was in charge of the electrical work. The Ferro Concrete Construction Co., Cincinnati, with H. D. Loring in charge, was the general contractor.

Cotton in House Construction

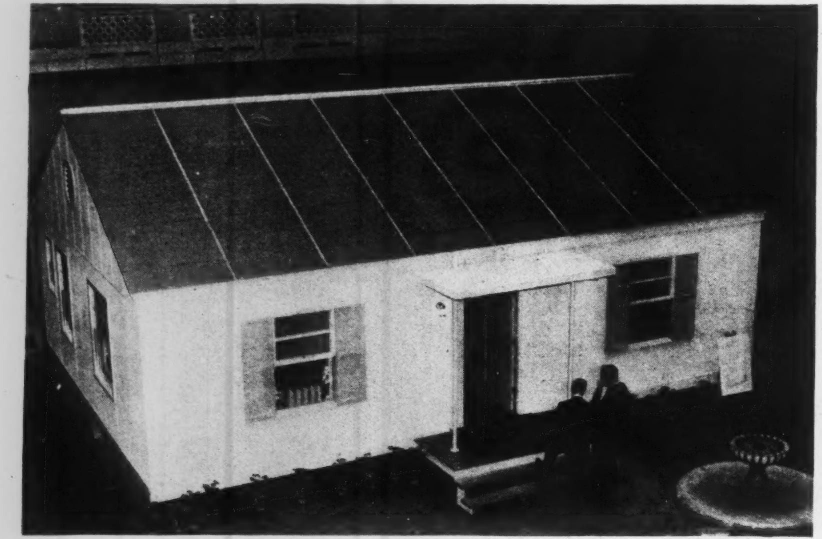
THE "COTTON HOUSE" was conceived and designed to fulfill a twofold necessity—first, as an important consumer of the country's No. 1 surplus agricultural commodity, and secondly as an important step in low-cost housing with especial reference to our defense needs. So says the U. S. Department of Agriculture, which is featuring an exhibit of this new type house in Washington, D. C.

Erected in 62 man-hours

Each structural unit is prefabricated in such manner that the house can be erected in 62 man-hours, and it has an additional advantage in that it can be demounted and re-erected on another site for additional years of service. One-third of a bale of cotton is used in the flameproof fabric which covers the outside and inside walls and ceilings. More than one bale of cotton is used for the blanket of flameproof insulation in the outside walls and ceilings.

Wall sections

The prefabricated wall sections are made with $\frac{5}{16}$-in. Douglas fir plywood which has been covered with 4 oz. cotton fabric hot-pressed to the plywood by the use of a synthetic resin adhesive. This provides a "canvassed" surface that is ideal for any decorative scheme that may be desired. The beauty is more than skin deep, for the cotton fabric permeated with this synthetic material provides a high degree of resistance to the passage of water vapor and, accordingly, assures against the possibility of moisture condensation within the wall space. Complete elimination of all moisture in the construction process is said to be definite assurance against subsequent cracks in the walls, floors and ceilings, and provides a dry surface suitable for immediate painting and permits immediate occupancy.



Prefabricated "cotton house" featured in an exhibit by the U. S. Dept. of Agriculture. Plywood wall, ceiling and roof sections are covered with cotton fabrics and flameproof cotton is used for insulation.

The floor, sidewall, ceiling and roof sections are all constructed of stress-covered panels following the principles developed by the Department of Agriculture's Forest Products Laboratory. This method permits the use of 1 x 3-in. studs on 12-in. centers, yet when bonded to the inner and outer plywood surfaces with waterproof resins, they constitute a box beam which makes a load-bearing wall far stronger than the conventional wall of 2x4's. Floor panels loaded to 128 lb. per sq.ft. over a 5½-ft. span showed a maximum deflection of only 0.19 in. This phenomenal stiffness is developed because the full strength of the material is structurally utilized; the upper surface being under compression, the lower surface in tension. The ceiling, sidewall, and floor units are tied down to the sills by a system of steel rods.

Adaptable to any climate

This type of construction with moisture-proof, and fire-resisting insulation inside and out is said to have successfully withstood the extremes of climate from the tropical Wake Islands to the rigorous winters of Point Barrow, Alaska—in either case improved in comfort by the use of blankets of cotton insulation.

Further details regarding cotton insulation may be obtained from the Marketing Division, Surplus Marketing Administration, United States Department of Agriculture, Washington, D. C.

Cantilever Forms for Shasta Dam

***Contents in Brief**—Cantilever forms are used for 5-ft. concrete lifts on Shasta Dam, second largest concrete structure ever undertaken. Vertical studs carry the concrete thrust without use of wales. Panels are 50 ft. long and designed for raising with three roller-chain jacks on A-frames. Form is entirely free of projections which might catch 8-yd. cableway bucket.*

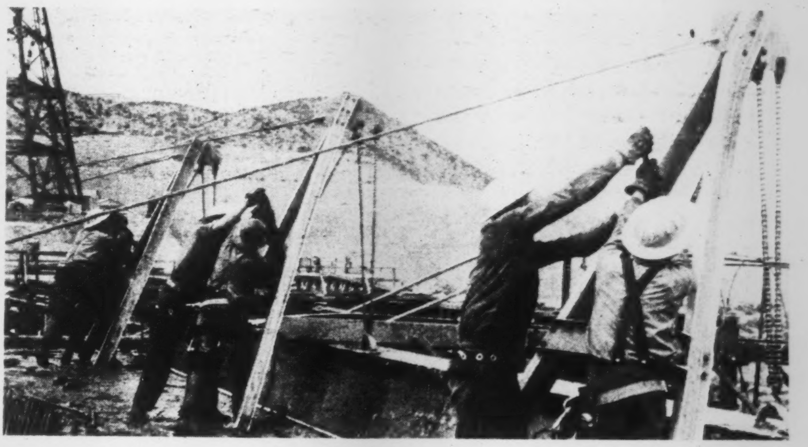
CANTILEVER FORMS made of timber are being used with notable success, the contractor reports, on Shasta Dam. With the 72-hr. time limit before forms can be moved (under specifications for slow-setting cement) and with 5-ft. concrete lifts on blocks, chiefly about 50 ft. square, the major requirements for the forms are the same as on other large dams designed by the U. S. Bureau of Reclamation. An account of cantilever forms used on Friant Dam appeared in *Engineer News-Record*, Apr. 10, 1941, p. 56.

In plan there are 373 vertical blocks for concrete at Shasta Dam, 104 requiring forming on all four sides; 94 require forming on up and downstream faces; 91 require forming on two sides and 84 require no forms except for 12 lifts on the downstream face nearest the top of the dam. Altogether there will be 32,327 five-foot lifts which are to be made with 72,606 moves of form panels. Thus it is highly desirable from the contractors' point of view to have forms that are simple and easy to move.

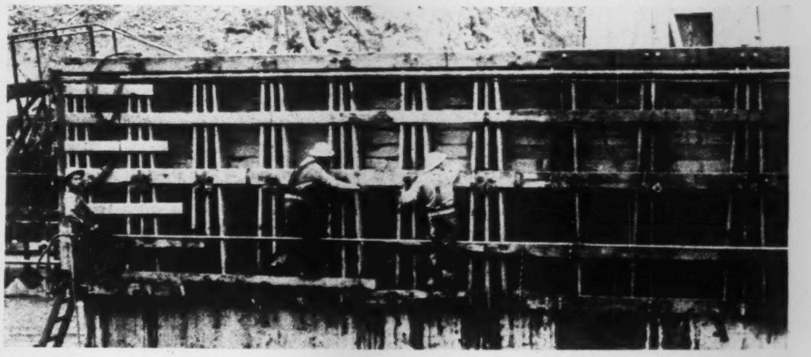
The forms, specially designed for this job, are light enough to be handled conveniently by small A-frames and roller-chain jacks so the form crews can function without tying up equipment, such as cranes or cableways. The forms not only leave the space within the blocks free from the struts and the tie-wires necessary on the old type of forms, but there is also freedom from any form of anchor bolts up to the time the individual concrete pour nears completion.

Three different types of the cantilever form panels are used at Shasta, forming: (1) transverse joints, (2) upstream longitudinal joints and (3) downstream longitudinal joints. In the two latter, the major distinction is the position and inclination of the shelf or shoulder designed to receive (and to be normal to) the thrust from the resultant of forces against the dam. As this resultant inclines downward, such a shoulder must have opposite projection in up and downstream form panels. Otherwise the up and downstream forms practically duplicate one another. (Only transverse and downstream forms are shown in accompanying drawing.)

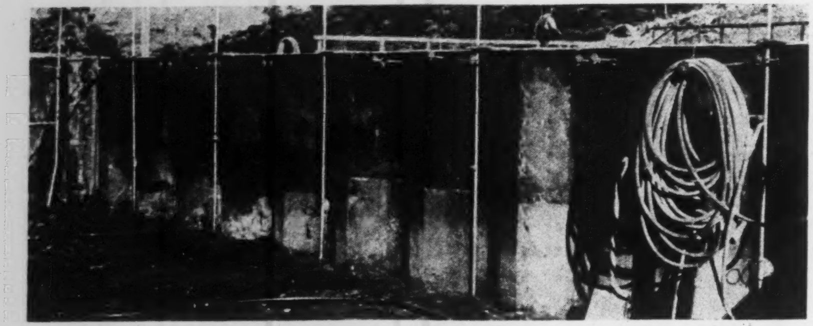
The transverse form has its vertical studs separated along the lower edge because the vertical keys in the concrete along these transverse joints have widths of only 6 in. in the plane of the joint. In order to allow central space for the two bolts needed in this 6-in. width, the studs are spread at the bottom and are used in sets of three instead of the pairs that suffice in the longitudinal form panels. The bolt spacing in both types of longitudinal joint forms is 24 in. Panels used for the transverse forms, on the other hand, require bolts located in the outer faces of the keys, that are in a plane parallel to the joint. Thus a 36-in. spacing is necessary to bring these bolts to the required location



A-frames with roller-chain jacks, each operated by two workmen, lift 50-ft. form panel. More than 72,000 moves of these panel forms are required during concrete placing at Shasta Dam.



Tightening the middle row of tie bolts on a cantilever form panel. Note the wedges hanging from the bottom of the forms, which are used to secure exact alignment.



Clean and unencumbered inside face of a form, which is ready for the placing of a 5-ft. lift of concrete. Note the cooling pipe on the surface of the concrete.

and two are used, close together, in each key face.

An essential feature of the cantilever design in all three types of forms is the three horizontal rows of bolts, top, middle and bottom, which are adjusted to bring the forms into a true vertical plane or, on the downstream face, into the plane with the prescribed inclination. The tiebolts used are 3 ft. long, $\frac{5}{8}$-in in diameter and have a 4-in. washer at the inner end to serve as an anchor after the concrete has hardened. Near the face of the concrete these tiebolts connect to an inside threaded rod, drilled and tapped in a job shop, which extend to the exterior of the form.

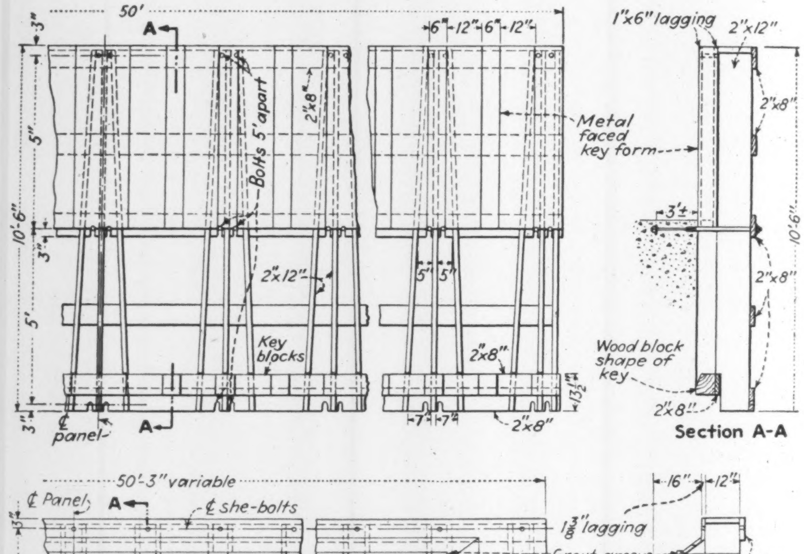
Before the forms around any concrete block are raised, reference points are set with a transit in the four corners of the previous pour. From these points the foreman of the form crew can determine the proper vertical plane for the new position by measuring directly from the points or from plumb bob lines held on the points.

Roller-chain jacks and A-frames

When a form panel is to be raised, the A-frames with ratchet jacks for hoisting are put in position, tied back to anchors in the concrete and the jacks are tightened up on the three steel loops provided in the tops of the panels for lifting. The inside threaded bolts in all three rows are then unscrewed and withdrawn. When the weight is hanging from the A-frames, the panel can be raised by six men, two on each jack handle, to a level 5 ft. above the previous position. Here the panel is fastened in place by threading the bolts onto the tierods, each bolt engaging a rod in a row 5 ft. above the one previously used.

The adjustment to the exact vertical plane is made by manipulation of the inside threaded bolts in the two lower rows plus the use of wooden wedges along the bottom of the panel. To make these wedges effective and to decrease wear on the surface of the form against which they bear, they are backed up by blocks which have a face parallel to the face of the wedge. These blocks are firmly nailed to the lower edge of the form. The wedges are fastened to chains so that when not in use they remain attached to the form panel and hence move up, without any attention on the part of the crew when the panels are raised. Pipes for spraying curing water against the outer face of the form (served through hose connections at panel ends) are also permanently attached to each panel.

The three rows of bolts are exactly 5 ft. apart vertically. Thus when a form panel is moved up, the bolts in each row will come exactly opposite the tierods previously threaded to the next higher row of bolts. To provide a 3-in. overlap at top and bottom, the form panels are made 10 ft. 6 in. high. The horizontal length, ordinarily, is 50 ft. To facilitate placing the form panels, slots instead of holes are provided for the middle and bottom rows of ties. Thus when the


50'
A
3"
5'
10'-6"
3"
5'
3"
℄ panel
Bolts 5' apart
2"x8"
2"x12"
Key blocks
6"
12"
6"
12"
5"
5"
2"x8"
7"
7"
13½"
2"x8"
1"x6" lagging
2"x12"
2"x8"
Metal faced key form
3'±
10'-6"
2"x8"
Wood block shape of key
2"x8"
Section A-A
50'-3" variable
℄ Panel
℄ she-bolts
5'
3"
4"x5"x11½" block
2"x12" studs x10'-6"
15¾"
18¾"
18¾"
6"x12"
5"
5"
Slotted access for bolts
16"
12"
1⅜" lagging
Grout groove
1"x6"
2"x8"
Top of previous pour
3'±
2"x8"
4"x5"x11½" block
2"x8"
Section A-A

Cantilever form panels for transverse joints (above), and downstream longitudinal joint (below). Upstream longitudinal joint form is similar but has key shaped differently to be normal to thrust of completed structure.

form panel is raised it can be lowered slightly and be guided to place over bolts already anchored in the concrete. Only the bolts in the bottom row have to be entirely withdrawn. After the panel has been lifted, they are inserted in holes of the top row, ready to "spot" the next row of tiebolts.

When the job started the A-frames used were job-made assemblies of standard pipe sizes. Later these were replaced by A-frames made of duralumin channels which weigh only about half as much as the pipe frames and are stronger. The bottoms of the frames are pointed to prevent slippage on the concrete surface.

The panels used on the downstream face are required to be curved in the plane of the downstream face of the dam which is on a radius that varies with the height, from 2,100 to 2,470 ft. This slight deflection is put in each panel by tightening up a little more on the ties near the middle of the row than at the ends. This can be done, in accordance with a table supplied to each foreman, in such a way that a smooth and continuous curve is obtained on the exposed face of the dam.

Shasta Dam is being built for the Bureau of Reclamation. S. O. Harper is chief engineer, Denver; Ralph Lowry, construction engineer and Grant Bloodgood, field engineer at Shasta Dam. The contract for construction of the dam is held by Pacific Constructors, Inc., Frank T. Crowe, general superintendent.

Air Lift Excavates Cofferdams

A SIMPLE AIR LIFT was used by J. Rich Steers, Inc., to excavate numerous small cofferdams on a section of the East River Drive in New York City. The cofferdams, all of steel sheetpiling, varied in size and shape from 5-ft. square to 6-ft. round, and from 20 to 66 ft. in depth. They were built for the foundations of a double-deck bridge section of the drive just off the Manhattan shore at 86th St.

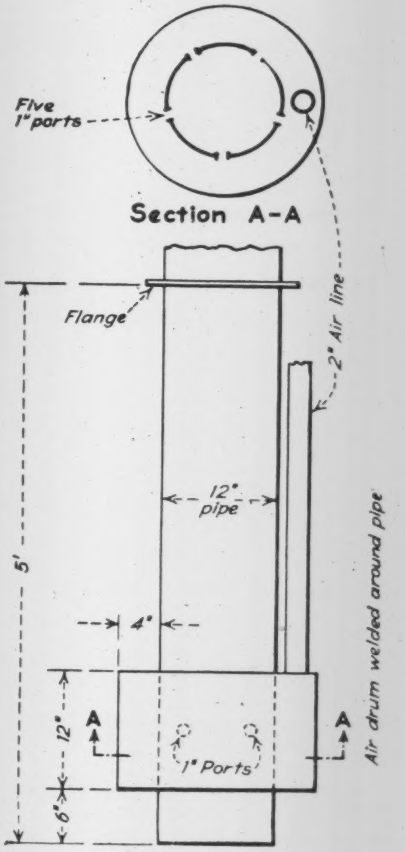
The air lift (see drawing) consists of a 5-ft. length of 12-in. pipe, around which, 6 in. from the lower end, was welded a 20-in. steel drum 12 in. high. The drum was sealed top and bottom by ring plates. A 2-in. air pipe was attached to the drum through the top ring plate. Through the pipe within the drum, were five equally-spaced 1-in. ports for admission of air from drum to discharge pipe. A bank of three portable compressors, aggregating 900 cu.ft. per min. capacity, supplied air to the drum at 100-lb. pressure.

Simple air lift excavates small cofferdams by throwing out a 12-in. stream of mud and water.

Several of the piling sheets in each cofferdam were either driven or cut off well below water level to permit plenty of water to flow into the cofferdam during operation of the air lift. The air lift, attached to a riser pipe terminating in a 12-in. hose at the upper end, was handled by a floating derrick.

In operation, the pipe assembly was held in vertical position by the derrick line with the bottom of the lift about 8 in. above the top of ground within the cofferdam. The lower end of the lift was moved around the area to be excavated by a diver, who also signaled the derrick man, through telephone instructions to the tender, when the pipe was to be lowered as the excavation deepened.

The air, entering the pipe through the ports, created a suction through the bottom opening similar to that of a dredge pump. Silt, sand, gravel, clay and small boulders were all easily excavated, though fastest progress was made through sand and gravel. Boulders up to 8 in. were lifted without trouble. The deeper the water became, the better the air lift worked because of the increased hydrostatic head outside the pipe.



Details of the air lift.

As the piers are all close to the shore, far from the navigation channel, the discharge was directly into the river. In good ground, the excavation rate was from 20 to 30 cu. yd. of solid material per hour. The discharge was estimated to contain about 15 percent solids. A lift was made up of 10-in. pipe, which worked just as well as the larger assembly.

J. Rich Steers, Inc., was contractor on Section 6 of the East River Drive, 79th to 90th Sts., built by the Department of Borough Works, Manhattan. John Malcolm was superintendent for the contractor.

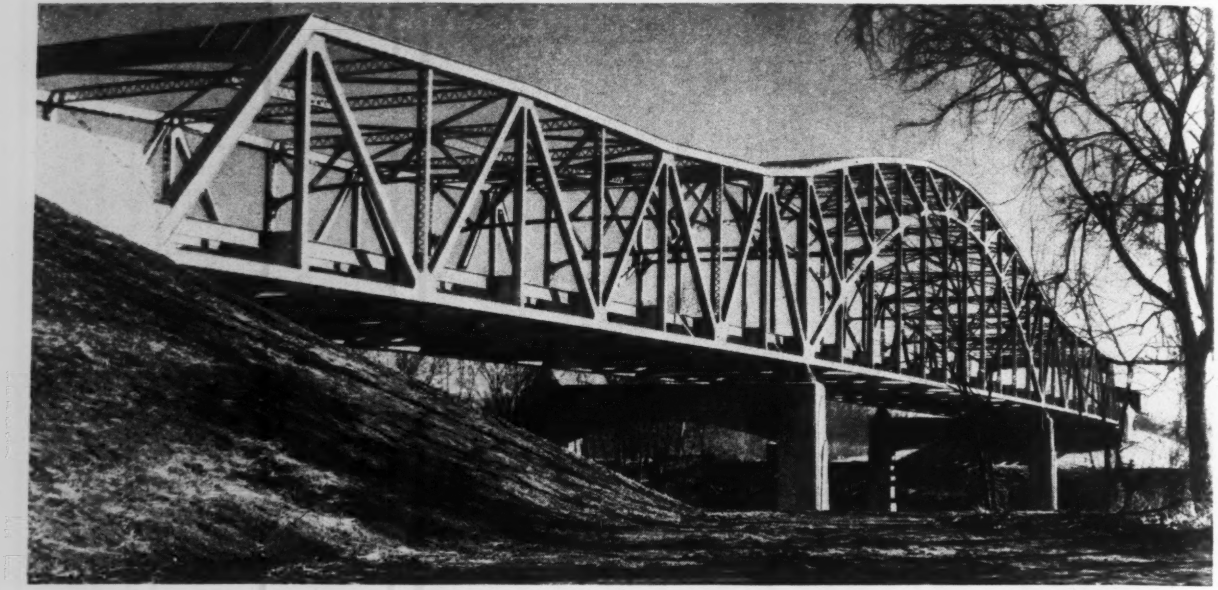


Fig. 1. Meramec Bridge near St. Louis is first of its type in United States.

Continuous Tied Arch Built in Missouri

Howard H. Mullins

The Engineer Board, Fort Belvoir, Va.
Formerly Design Engineer, Missouri State Highway Department
Jefferson City, Mo.

***Contents in Brief**—First of its type in the United States, bridge over Meramec River near St. Louis has main span of 264 ft. and side spans of 192 ft. Stress analysis was accomplished by general method of least work, coupled with the determination of influence lines by the method of elastic weights instead of by solving simultaneous equations. Rolled H-sections are used for tie member as well as for all other truss members except top chord, which is a built-up section.*

Of the Many unusual highway bridges built in recent years few were more novel than one recently constructed over the Meramec River, a short distance south of St. Louis, by the Missouri state highway department. The bridge is appropriately called a continuous tied arch, and is believed to be the only bridge of its kind in the United States, although structures of this general type, but using plate rib rather than framed construction, have been built in Europe. Also a framed structure of this type was constructed over the St. Lawrence River in Canada in 1934 (*ENR*, May 17, 1934, p. 621), and a similar structure was studied in connection with the East Bay crossing at San Francisco (*ENR*, Mar. 24, 1934, p. 371).

Since the Meramec River Bridge is located in a region that has been called the playground of St. Louis an effort was made to secure a structure of reasonable esthetic fitness. At the same time economic considerations were important, and accordingly, several types were studied, among them a series of three single-span plate-rib tied arches; a continuous plate rib tied arch; a three-span continuous truss; a statically determinate three-span continuous truss; a cantilever truss; and a self-anchored suspension bridge. Accurate estimates showed the continuous tied arch to be the most economical. The cost of the substructure (two abutments of open-bent type on steel H-piles and two piers founded on rock) was $114,013, and of the superstructure $214,197. The bridge was designed under the 1935 A.A.S.H.O. specifications except that the wind load was increased one-third. M-20 loading was used.

Of three spans, 192-264-192 ft., the bridge is located on a dual highway and is provided with two 21-ft. roadways separated by a 4-ft. width of open grid flooring. The continuity of the trusses and the action of the arch tie produce a structure which is threefold indeterminate. A condition of single redundancy was also produced by the double intersection diagonals at the center of the arch truss. These double diagonals were used to permit a pleasing truss outline.

Stress analysis

The solution of the stresses for this type of structure may be accomplished by one of several methods, but the general method of least work was used to develop the three necessary equations. The procedure will be sketched below, and additional data will be found in a brief discussion that appears in the April, 1941, A.S.C.E. *Proceedings*, p. 680.

$$\text{The total work } W = \frac{1}{2}\sum \frac{S^2 l}{AE} \quad \ldots\ldots (1)$$

Let X_a, X_b and X_c represent the three unknown stresses, reactions, or parameters. Then,

$$\left.\begin{aligned} \frac{\delta W}{\delta X_a} &= \sum \frac{Sl}{AE} \cdot \frac{\delta S}{\delta X_a} = 0 \\ \frac{\delta W}{\delta X_b} &= \sum \frac{Sl}{AE} \cdot \frac{\delta S}{\delta X_b} = 0 \\ \frac{\delta W}{\delta X_c} &= \sum \frac{Sl}{AE} \cdot \frac{\delta S}{\delta X_c} = 0 \end{aligned}\right\} \ldots\ldots (2)$$

$$\text{But, } S = S_o + S_a X_a + S_b X_b + S_c X_c \quad \ldots (3)$$

where S_o = the stress in the statistically determinate structure, Fig. 3, due to the external loads only.

S_a = stress due to $X_a = 1$
S_b = stress due to $X_b = 1$
S_c = stress due to $X_c = 1$

Differentiating Eq. 3 with respect to each of the unknowns, X_a, X_b, and X_c,

$$\frac{\delta S}{\delta X_a} = S_a; \qquad \frac{\delta S}{\delta X_b} = S_b; \qquad \frac{\delta S}{\delta X_c} = S_c.$$

Substituting these values in Eq. 2 the necessary three equations are as follows:

$$\left.\begin{aligned} &\sum \frac{S_o S_a l}{AE} + X_a \sum \frac{S_a^2 l}{AE} \\ &\quad + X_b \sum \frac{S_a S_b l}{AE} \\ &\quad + X_c \sum \frac{S_a S_c l}{AE} = 0 \\ &\sum \frac{S_o S_b\, l}{AE} + X_a \sum \frac{S_a S_b l}{AE} \\ &\quad + X_b \sum \frac{S_b^2 l}{AE} \\ &\quad + X_c \sum \frac{S_b S_c l}{AE} = 0 \\ &\sum \frac{S_o S_c l}{AE} + X_a \sum \frac{S_a S_c l}{AE} \\ &\quad + X_c \sum \frac{S_b S_c l}{AE} \\ &\quad + X_c \sum \frac{S_c^2 l}{AE} = 0 \end{aligned}\right\} \ldots (4)$$

These three simultaneous equations may be solved for the unknowns. However, the work of computation is reduced if the location of the coordinate axes is chosen so that the terms with different subscripts will vanish. We wish to make

$$\left.\begin{aligned} &\text{(a)} \sum \frac{S_a S_b l}{AE} = 0 \\ &\text{(b)} \sum \frac{S_b S_c l}{AE} = 0 \\ &\text{(c)} \sum \frac{S_a S_c l}{AE} = 0 \end{aligned}\right\} \ldots\ldots\ldots\ldots (5)$$

Each equation now contains only one unknown from which we write.

$$\left.\begin{aligned} X_a &= -\frac{\sum \frac{S_o S_a l}{AE}}{\sum \frac{S_a^2 l}{AE}} \\ X_b &= -\frac{\sum \frac{S_o S_b l}{AE}}{\sum \frac{S_b^2 l}{AE}} \\ X_c &= -\frac{\sum \frac{S_o S_c l}{AE}}{\sum \frac{S_c^2 l}{AE}} \end{aligned}\right\} \ldots\ldots\ldots (6)$$

The conditions expressed in Eq. 5 will be satisfied if the axes are located as shown in Fig. 3, a.

The intersection of the axes is located by Eq. 5, (c). The stresses S_c due to the force $X_c = 1$ acting at a distance y above the arch springing may be expressed thus,

$$S_c = y\,S_a + S_H \quad \ldots\ldots\ldots\ldots\ldots\ldots (7)$$

where S_H is the stress in the two-hinged arch shown in Fig. 3e, due to $H = 1$. Substituting this value of S_c in Eq. 5, (c) and solving,

$$y = -\frac{\sum \frac{S_a S_H l}{AE}}{\sum \frac{S_a^2 l}{AE}} \quad \ldots\ldots\ldots (8)$$

It would be a simple matter to place a unit load at the various panel points of the structure shown in Fig. 3a. and compute the stresses S_o. Influence lines may then be computed for the redundants as indicated in Eq. 6. A more expeditious method, however, is to load the statically determinate system shown in Fig. 3, successively with the elastic weights due to the stresses S_a, S_b and S_c, and calculate the bending moments at the various panel points due to these elastic weights. If we divide the bending moment values at the various panel points by the denominators of Eq. 6 we have the influence lines for X_a, X_b and X_c, respectively. By this method the influence lines shown in Fig. 4 were computed after which an influence line was computed for each member of the structure.

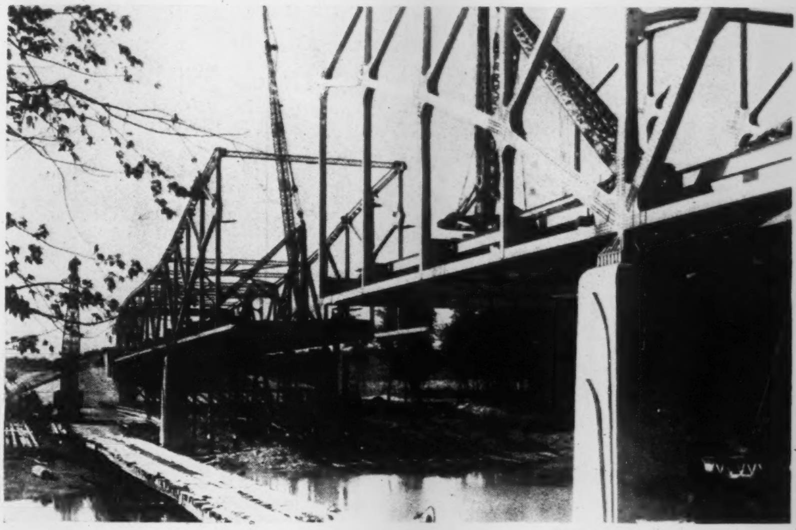


Fig. 2. Center span was erected by cantilevering using a deck traveler after the side spans had been built on falsework by a crawler crane.

Trusses

Slightly over 1,087 tons of steel were required for the Meramec Bridge. A Warren type of truss was selected as being the most suitable for use in the side spans, but for the arch span, Pratt type bracing was used in order to get a satisfactory slope for the diagonals. (Fig. 5). The upper chord of the truss consists of a plate and angle section. Where the compressive stress was low top and bottom lacing was used.

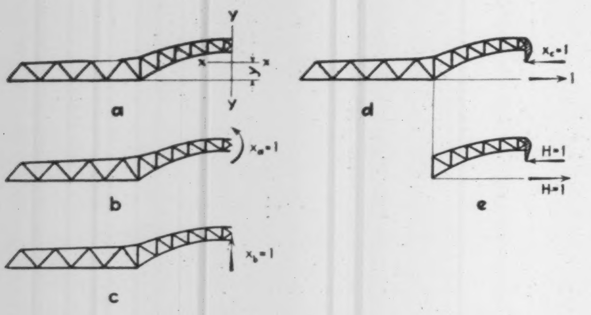
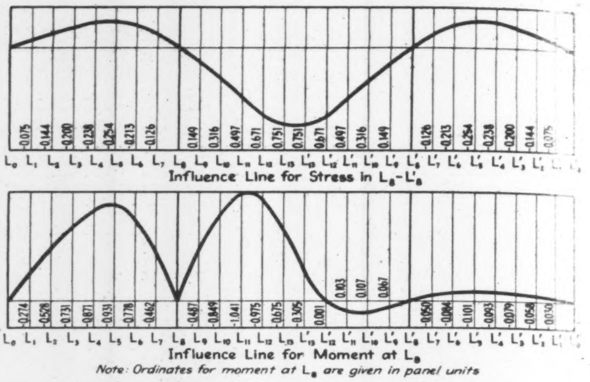

y
x
y
y
a
$x_a = 1$
b
$x_b = 1$
c
$x_c = 1$
1
d
H=1
H=1
e

Fig. 3. By cutting the continuous truss at the center a statically determinate structure is obtained, which yields the equations necessary for computing the unknown stresses.



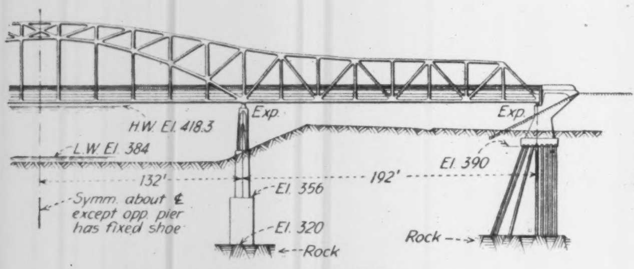
Note: Ordinates for moment at L_8 are given in panel units

Fig. 4. Typical influence lines calculated from elastic weight loading of the structure shown in Fig. 3. Such influence lines were computed for each member in the bridge.

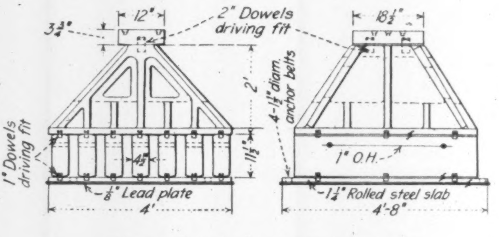
where the stress was tension only, tie-plates were used; and where the compression stress was important a cover plate was used on top and lacing on the bottom.

For the web system, lower chord, and arch tie 14-in. wide flange sections were used. The details were made up using ½-in. gusset plates. For some of the members it was necessary to use ½-in. plates riveted to the flanges of the wide-flanged sections. These plates were then in the plane of the gusset plates to which they could be spliced. At the ends of the side spans and over the main piers two thicknesses of gusset plate were required. All gusset plates were curved to eliminate the sharp, unsightly angles produced by straight-cuts.

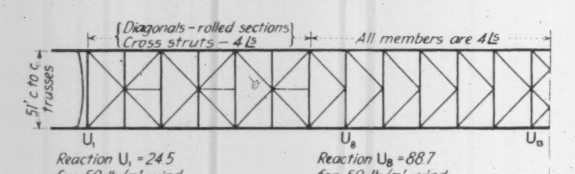
The hangers in the arch span were also made of 14-in. wide flange sections. Cable hangers were consid-


Exp.
Exp.
H.W. El. 418.3
L.W. El. 384
132'
192'
El. 390
El. 356
Symm. about ℄ except opp. pier has fixed shoe
El. 320
Rock
Rock

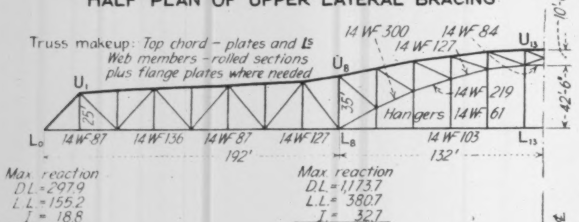
HALF GENERAL ELEVATION


3¾"
12"
2" Dowels driving fit
18½"
2'
4-1½" diam. anchor bolts
1" Dowels driving fit
4½"
11½"
1" O.H.
⅛" Lead plate
4'
1¼" Rolled steel slab
4'-8"

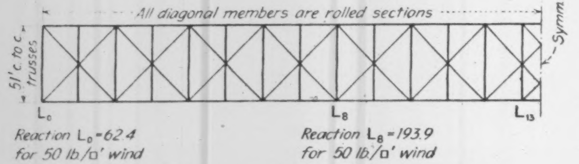
DETAILS OF EXPANSION SHOE


Diagonals – rolled sections
Cross struts – 4 Ls
All members are 4 Ls
51' c. to c. trusses
U_1
U_8
U_{13}
Reaction U_1 = 24.5 for 50 lb./□' wind
Reaction U_8 = 88.7 for 50 lb./□' wind

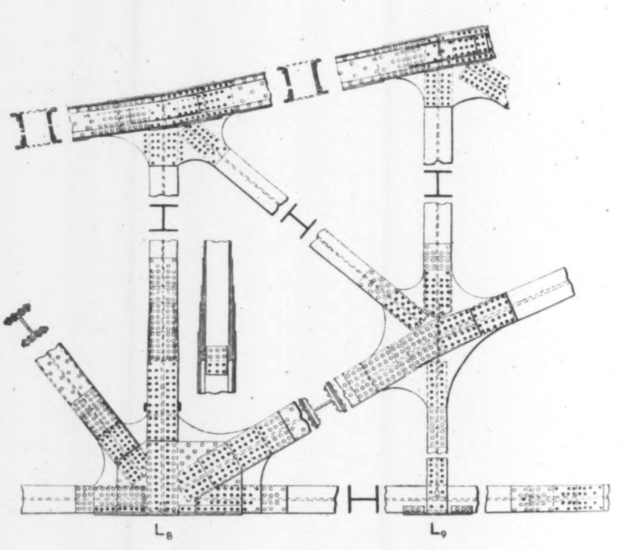
HALF PLAN OF UPPER LATERAL BRACING


Truss makeup: Top chord – plates and Ls
Web members – rolled sections plus flange plates where needed
14 WF 300
14 WF 84
14 WF 127
U_1
U_8
U_{13}
10'-6"
42'-6"
25'
35'
14 WF 219
Hangers
14 WF 61
L_0
14 WF 87
14 WF 136
14 WF 87
14 WF 127
L_8
14 WF 103
L_{13}
192'
132'
Max. reaction
D.L. = 297.9
L.L. = 155.2
I = 18.8
Total = 471.9
Max. reaction
D.L. = 1,173.7
L.L. = 380.7
I = 32.7
Total = 1,587.1

HALF ELEVATION TRUSS


All diagonal members are rolled sections
51' c. to c. trusses
Symm. about ℄
L_0
L_8
L_{13}
Reaction L_0 = 62.4 for 50 lb./□' wind
Reaction L_8 = 193.9 for 50 lb./□' wind

HALF PLAN OF LOWER LATERAL BRACING



TYPICAL TRUSS DETAILS

Fig. 5. Structural details of continuous tied arch bridge over Meramec River near St. Louis.

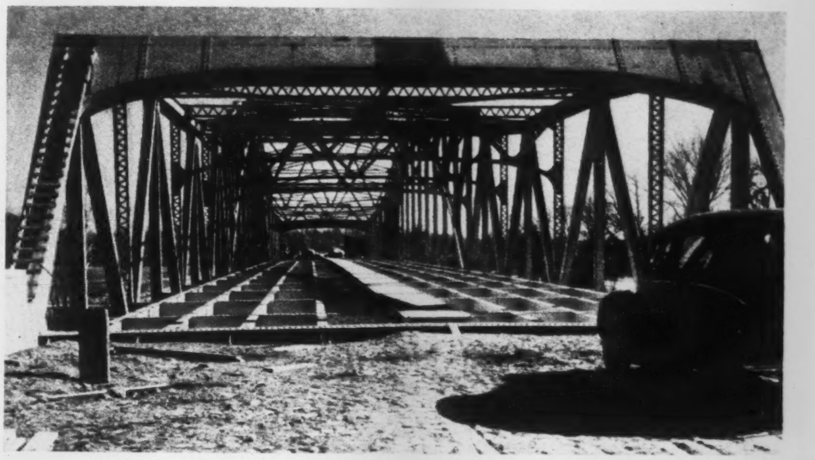


Fig. 6. Solid, shallow portal is a feature of the bridge. The center section dividing the roadway is covered with an open steel grid.

ered, but were found to cost more than the rolled sections which were also designed to support the lower arch chord laterally between the upper and lower lateral systems.

Lateral systems

Both the upper and lower lateral systems were also analyzed as three-span continuous systems. The lower lateral system is designed to take tension only, and the sections consist of wide-flange tees. For the arch span a *K* system of lateral bracing was used, consisting of four angles connected by tie-plates and lacing.

A rather shallow plate portal was used as it was felt that it would present a more pleasing appearance, when seen while approaching the bridge, than the conventional framed portal, Fig. 6.

The bridge was designed to have sway frames over the main piers only. However, sway frames were later placed at panel points U_4, U_6, U_{10} and U_{12}. No lateral bracing is used in the plane of the lower arch chord.

Cast steel bearings

The trusses are placed 51 ft. c.c. and have a maximum end reaction of 472 kips and a maximum reaction on the piers of 1,587 kips. The fixed shoe is placed on pier No. 1, and with this arrangement it was necessary to design one of the main pier shoes and both end shoes for expansion movement. All pins were eliminated and the truss bearing plate was curved to a 20 ft. radius and fastened to the flat surface of the cast steel shoes by 2-in.-dia. dowels. It is believed that this method is more economical and efficient than the method of using pins to connect the truss and shoes.

The main pier expansion shoe rests on seven structural steel rollers 11½ x 4½ in. x 4 ft. long which set on a rolled steel base plate. The castings were made up in cellular form, so as to reduce the bending stresses and to distribute the loading more uniformly on the concrete bearing surfaces.

Floor system

It was found that a 24-ft. panel length gave a minimum weight of metal in the floor system and that the weight of floorbeams was just equal to the weight of the stringers. Each dual concrete roadway is supported by five 21-in. wide flange sections, spaced 5 ft. on centers, which frame into the 5 ft. deep girder type floorbeams.

The connections of these floorbeams to the truss were milled to a bevel equal and opposite to the rotation caused by the dead load deflection, to eliminate the secondary bending in the truss verticals and arch hangers, which would otherwise be induced.

Superstructure erection

The side-span steel was erected complete on pile falsework by a crawler crane operating on the ground, Fig. 2. When the steel erection had reached the main piers, the crane was then used to erect a stiff-leg derrick over each main pier. Steel erection then proceeded by the cantilever method from each main pier. No falsework was used in the main span. To connect the bridge at the center a method involving the lowering of the ends of the side-span trusses was used. The end shoes were removed and the ends of the side-spans were lowered about 4½ in. onto blocking, allowing the whole truss to rotate on the pier shoes. The remaining steel was then connected and the ends of the side spans were jacked up and the end shoes replaced.

Personnel

The bridge was built by the Missouri State Highway Department, of which C. W. Brown is chief engineer and N. R. Sack is bridge engineer. The design was prepared by the writer, assisted by Ray Adams on the substructure. J. J. Krebs was resident engineer in direct charge of construction.

Massman Construction Co., Kansas City, Mo. was the general contractor. The steel was fabricated by Stupp Brothers Bridge and Iron Works. William O'Donnelly was foreman for the contractor on construction.

Snow Promises Water in Plenty for California

PERIODICAL STUDIES of snow conditions in the mountains by California Co-operative Snow Surveys indicate an ample supply of water this summer throughout the state. This is reported by the State Division of Water Resources, which predicted (as of April 1) that for streams heading in the Sierra Nevada the flow will be 20 percent above normal. The snow pack was only slightly above normal in the north, but increased rapidly toward the south and was very heavy in all areas east of the San Joaquin Valley, where it was 30 percent above the seasonal average.

For individual streams, the runoff is predicted to range from 83 percent of normal in the American River to 180 percent of normal in the Kern River. In the drainage areas tributary to the Shasta Reservoir, the snow pack was 7 to 19 ft. deep, with an equivalent content of 39 to 109 in. of water. Runoff figures compiled by the U. S. Geological Survey indicate that if Shasta Dam had been completed, the flow past its site since Oct. 1, 1940, would have more than filled the reservoir to its capacity.

BUILDING DESIGNERS' LIBRARY

A New Approach to the Problem Of Concrete Wall Reinforcing

F. N. Ropp
Structural Engineer, Los Angeles, Calif.

***Contents in Brief**—In long, reinforced-concrete buildings of the multiple-housing type the common problem of diagonal cracking in the walls at window and door openings is exaggerated. Study of the cracking in a structure of this type indicated the stresses induced by the shrinkage of the floor slabs might be the cause, and reinforcing is designed to meet this condition.*

THE INADEQUACY of the present methods of reinforcing building walls to prevent the cracking at the corners of openings has long been recognized, but nothing has been done about it except to keep adding steel around the openings to the capacity of the wall thickness, and the disgust of building contractors. The stresses set up in the walls evidently are such that the ordinary jamb, head and sill bars, together with all the diagonal corner bars that can be crowded in, are not quite adequate, because the cracks still develop.

An opportunity was afforded to examine a group of relatively long concrete buildings of similar design, all of which were symmetrical about the center line. The buildings were two stories high with concrete walls, concrete first and second floors and wood roofs. They were founded on what appeared to be a uniform foundation material, but the resulting cracks showed a pattern that was almost uniform through the entire group, and almost symmetrical about the center line of each building.

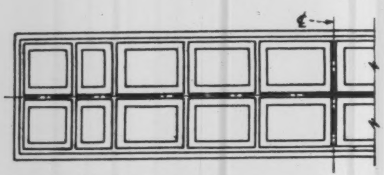
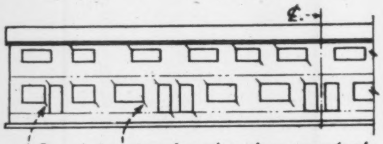


Fig. 1. Foundation plan.

An interesting observation was that the cracks were confined to the first-story walls alone, originating in openings, at bottom corners nearest the center line of the building and at top corners away from the center line. The direction of the cracks varied from nearly vertical, at those openings close to the center line, reaching a maximum slope from vertical at a point about three-fifths of the distance to the end of the building, and then reduced in slope from that point on.



Crack tendencies showing greatest slope from vertical at $\frac{3}{5}$ from ℄ out

Fig. 2. Framing elevation.

The fact that the cracks were confined to the first story, and the character and pattern of the cracks, suggested that possibly the second floor slab might be largely responsible for the condition, inasmuch as the second-story piers showed no cracks, but also had no slab over them.

With this as a starting point in an investigation, information was sought regarding the volume change of concrete in curing. From the Bureau of Reclamation handbook on concrete the shrinkage coefficients for varying water cement ratios and slumps were obtained. Assuming the coefficient for the most favorable mix practicable, and the tension modulus of elasticity for the concrete, the stress in the slab contributing to a side wall pull was computed, and was found to be relatively high.

Now, if it is assumed that the side walls have taken a considerable portion of their shrinkage prior to the pouring of the second floor slab, it is evident that a considerable distortion of some part of the building must result from shrinkage during the setting of the slab.

Assuming also that a portion of the slab shrinkage is resisted by the steel reinforcing parallel to the wall, the result is still the introduction of a very high moment in the walls, equal to the net pull of the shrinking slab times the height of the slab above the foundation. This moment would tend to bow the building to the extent of creating a variable soil resistance to the building load, probably parabolic in character, with a maximum near the center and a minimum at the ends.

With the building load uniform and the unit soil resistance variable, vertical shears will be set up in the side walls, being zero at the center and ends of the building and a maximum at about three-fifths of the distance from the center to the end. If the constant horizontal component of stress of the slab is coupled with the variable shear components, the resultants will have a directional change.

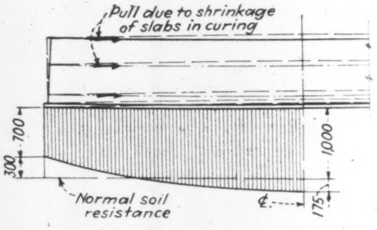


Fig. 3. Distortion due to slab shrinkage.

That there is a directional change in the resultant is evidenced by the observed directional change of the cracks, assuming that the cracks are approximately normal to the resultant stresses.

An illustrative example, with corresponding drawings, will indicate the problem which has been outlined and a possible solution. The foundation plan shows the structure, which is symmetrical about the center line, cut by crosswalls and a center longitudinal wall. The elevation indicates the two-story construction with numerous openings. These openings show the customary corner cracks that change in direction, reaching the largest slope from the vertical about three-fifths of the distance from center line to the end of the building.

The distortion of the building caused by the shrinkage of the slabs in curing is shown on an exaggerated scale, with the resulting variation of the soil resistance, due to this building distortion.

The vertical shear in the wall of the building, resulting from this variation in soil pressure, shows the influence of the crosswalls and the longitudinal center wall. The corresponding moment diagram permits the determination of the reinforcing required for the chords at the top and bottom of the wall.

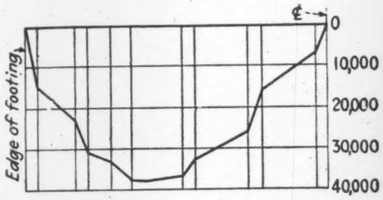


Fig. 4. Vertical shear in wall.

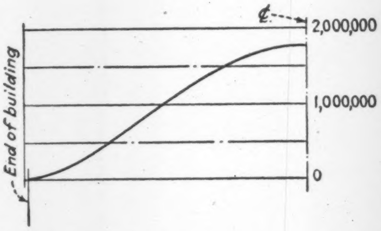


Fig. 5. Moment in wall.

Returning to the shear curve again, with the calculated safe shear capacity of the walls marked off, the excess shear requiring reinforcing is shown by the shaded area, together with the size and disposition of diagonal rods necessary to take this shear.

In determining the safe shear in the building wall the horizontal members of the wall must be figured as beams to carry the indicated shear load from piers across successive openings. The spandrel between first-story window soffits and second-story window sills, and the beam formed by the foundation wall, are weighted for relative carrying capacity and are reinforced as cantilever beams according to their weighted loads, which accounts for substantial steel reinforcing under the second-story window sills and at top of the foundation wall, and a full keying at the second floor through the construction joint.

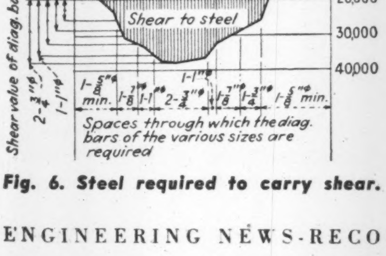


Fig. 6. Steel required to carry shear.

The final figure shows a wall elevation with the required steel indicated to carry the excess over the safe wall shear. The steel should be doweled into the foundation wall beam, bonded beyond all pour joints and anchored into the upper chord. It should slope at an angle of preferably not to exceed 30 deg. from the vertical, and should be placed as close to the corners of openings as coverage allowances will permit. Additional single bars, similarly placed, sloping in the opposite direction would be desirable.

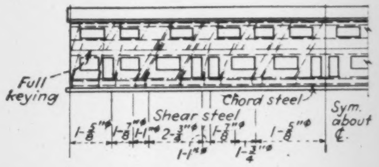


Fig. 7. Position of wall reinforcing.

The typical horizontal and vertical wall steel is to be used in addition to that shown, however the usual increased jamb bars, and diagonal bars across corners are not required.

A similar analysis can be made for the walls of any building, founded on a soil whose unequal settlement will produce a variable resistance to the building load. If the variations can be estimated or calculated, a system of wall reinforcing can be found to take care of the condition and avoid the troublesome cracking.

Some "do and don'ts" for concrete building construction, developed in collaboration with A. C. Zimmerman, architect, and John T. Vawter, engineer, and suggested by the foregoing analysis, follow:

Use a concrete mix requiring the minimum practicable water-cement ratio, providing required workability by the introduction of an admixture chosen for its ability to prevent agglomeration, so that a minimum of shrinkage of the concrete may be obtained.

Design the concrete mix to provide a compressive strength just safely over the required 2,000 lb. per sq. in. at the age of 28 days. Avoid designs that permit the concrete to attain high strengths. The use of larger aggregates is suggested.

Do not skimp on the shrinkage reinforcing, but rather increase over the usual code requirement of .002 and .0025 for floor and roof slabs respectively, keeping in mind that .006 would be the absolute maximum.

Provide substantial chord reinforcing at the top and bottom of all long building walls.

In all unbroken horizontal portions of walls, such as spandrels and foundation walls, provide reinforcing for beams acting as cantilevers to carry the shear loads across openings.

Impact of Defense On City Government

The impact of the national defense program is described as having a "tremendous effect" on the machinery of municipal government in a report by the American Municipal Association. The report, *Cities and the National Defense Program*, said that although communities near army camps and defense industry areas were most noticeably shaken out of routine, all cities had been touched in some way by the defense program in its progress during the past year.

Viewing the situation as of May, 1941, the Association points out in the report that city officials were now aware of two "fundamental facts:" (1) that whereas defense of the nation is a responsibility of the federal government, effective operation is "in large part an urban task" because defense industries must be in or near cities and require city services; and (2) that the federal government had begun to recognize the urban character of the defense program and was gradually assuming the responsibility of aiding cities in providing services to meet defense needs.

Between 250 and 400 cities have become "boom towns" because of defense industries or proximity of military posts, the report said. Water consumption has increased 10,000,000 gallons.

From Field and Office

Working problems and time-saving methods for engineers and contractors

Vertical Sight Distance Charts

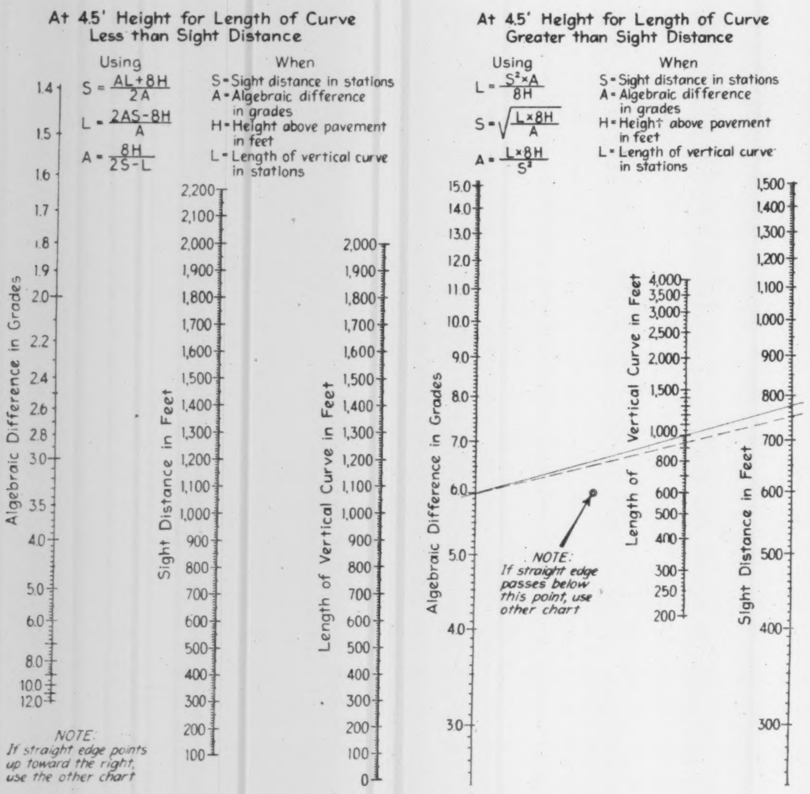
The solution to any vertical sight problem can be secured from one of the two accompanying charts. The relationship between vertical sight distance, algebraic difference in grades, and length of curve is presented in such a way that with any two given the third can be determined, and the result is always accurate enough for all practical purposes.

The principal advantage of this type of presentation is that the exact sight distance can be ascertained after the length of curve has been stepped up to the next 100 ft. or so for safety. Let us say that the user has an algebraic difference of 6.0 and is using a minimum of 750 ft. for his vertical sight distance. Placing a straightedge from 6.0 on the scale labeled "algebraic difference in grades" to 750 ft. on the scale labeled "sight distance in feet" on drawing at right, a curve of 936 ft. is required, as shown by dotted line. However, it is customary to increase the curve length to the next 50 or 100-ft. unit to allow for a little extra. Suppose the vertical curve is increased to 1,000 ft.; the straightedge is then run from 6.0 through 1,000 ft. and shows a sight distance of 775 ft. on the scale labeled "sight distance in feet", which is ample in this case.

Another advantage in this kind of chart is the wide range that it covers. No possible problem is omitted, any vertical curve length from 1 ft. to 4,000 ft., any sight distance from 100 ft. to 2,200 ft. and any algebraic difference from 1.4 to 15.0 is included.

The right graph is to be used when the curve is greater than the sight distance, in other words, when both cars are on the curve; and the graph at left, when the curve is less than the sight distance—that is, when the vehicles are on the tangen

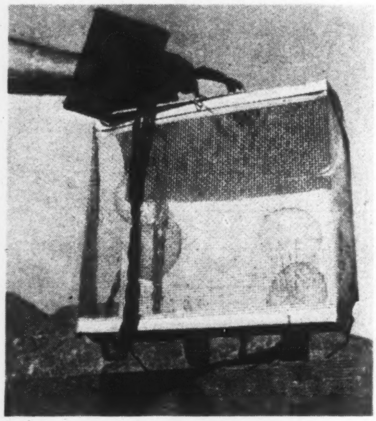
All six formulas are included that the user can solve the formula greater accuracy is desired.—Bil Turner, *Senior Designer, Tenness Highway Department, Nashvill Tenn.*



Charts for quick solution of sight distance problems.

Screen Saves Lamp Bulbs

Mortality of electric light bulbs used for night work on Grand Coulee Dam has been decreased by the use of screens over reflectors for the units used near where work is under way. Sandblast particles and other small fragments are kept from the bulbs by a galvanized screen of ⅛-in. mesh. A width of this screen is simply bent over the front of the galvanized metal reflectors carrying sockets for the lamps, and units hung in safety much closer to the work.



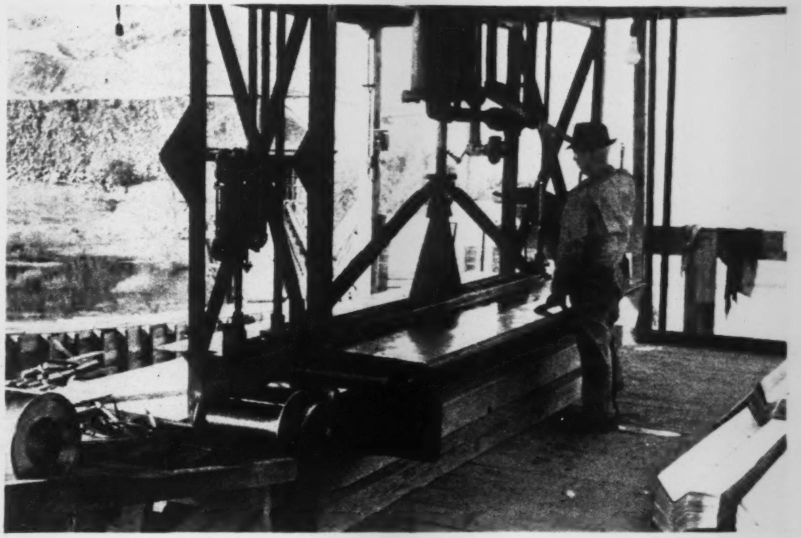
Construction lighting unit with a 1⅛-in. mesh screen to protect the lamps.

Watertight Blasting Splices

Proper insulation of wire for blasting work often presents a real problem during bad weather when covering the multitudinous array of splices with electrical tape becomes a backbreaking, time-consuming, and often hand-freezing job. To overcome these difficulties the author follows the simple procedure of heating ordinary tar or asphalt in a large frying pan or kettle over a plumber's furnace. The molten compound is then poured into various small pans and each blaster goes along the line, as shown by the author in the accompanying picture, dipping all wire splices. The time requires only one-tenth that previously spent, and the method makes a thoroughly watertight joint. Also the "boss" blaster has no misgivings when he checks with voltmeter for ground leakage. Connections insulated by the "hot dip" method can easily withstand total submersion or a deluge of rain and still fire 100 percent.

Another safety measure during blasting followed by the author is the removal of the whistle from the air compressor's shack and the carrying of it in the blaster's kit. Thus in a moment's notice the whistle can be screwed into a handy tee and valve on the airline serving the project and blown to warn everyone of the impending blast. Since no system of signals now need be arranged with an operating engineer, our practice is to have the chief blaster, prior to a shot, instruct a helper to "plug in" the whistle; have five whistles sounded to indicate five minutes for all workmen to get clear; and then a final long whistle for the actual firing. Later, when the chief is satisfied no unexploded charge remains, the "come back" signal can be sounded.—By PAUL C. ZIEMKE, *Milwaukee, Wis.*

Dipping in ordinary hot tar provides proper insulation of blasting wire splices.



Hydraulic press shaping 10-ft. lengths of copper strips for Friant Dam waterstop.

Copper Strips for Waterstops Shaped in Job-made Press

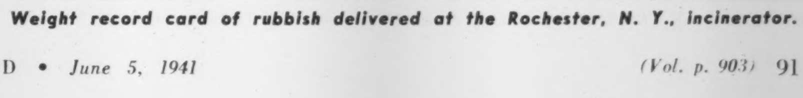
Large quantities of copper waterstops are used in the construction of Friant Dam and on the job the contractor has to shape flat copper strips into the prescribed form. The copper, of 20-gage thickness, comes to the job in rolls, 12 in. wide. Of this width 4½ in. is left flat and the remainder is bent into a V with 3-in. and 4½-in. legs respectively, as shown by those at lower right in accompanying photograph. This shaping is done speedily on a hydraulic press which operates shaper and cutter with a single lever.

A water pressure of 180 lb. per sq. in. is admitted by a 3-way valve to either side of a piston whose operation raises and lowers a shaping tool 10 ft. long. At one end of the shaper a cutter is operated by the same mechanism, moving up and down with the shaper. To start operations, a 10-ft. length of the copper strip is cut from the roll and is laid on the bed of the shaper. A similar length is unrolled (but not cut off) and is left under the cutter after having been carefully pulled out to the 10-ft. mark. Thus in a single operation the strip under the press is shaped and the next succeeding piece is cut to a measured length. In successive operations a length is pulled off the roll before each shaping movement, thus making it possible to speed up operation materially.

By locating the machine near the pump house, water pressure is conveniently at hand and the pump operator can put in his spare time shaping the copper. With this rig, finished waterstops, in 10-ft. lengths, can be turned out by one man at the rate of about 600 ft. per hour.

Weight Record for Incinerators

The record card illustrated is used at the Rochester, N. Y., incinerator plant. It is produced by a printomatic recorder in service on a 30-ton scale. The data recorded are shown clearly by the illustration; they are printed on duplicate cards and also on a roll of tape by one operation of the recorder. It will be seen that the cards give data for a reasonably full breakdown into time, amounts of rubbish collection by collection districts, and also of truck performance. Incidentally, the cards have helped in recovering valuable articles reported lost in the rubbish. This account is taken from *F-M News*, Nov.-Dec., 1940, published by Fairbanks-Morse & Co., Chicago, Ill.



NET WEIGHT	TRUCK NUMBER	DISTRICT	DATE & TIME
1010	078	056	MAR.11 P.M 12:03

DRIVER'S TICKET NUMBER

MATERIAL

DEPT OF PUBLIC WORKS - ROCHESTER, NEW YORK

Weight record card of rubbish delivered at the Rochester, N. Y., incinerator.

Notes on Sewage Disposal

A monthly summary of current developments conducted by William Rudolfs

SERVICE CHARGES — Sewer rental laws are rapidly increasing in favor. But in many cases municipal authorities are afraid that service charges may cause complaints and react unfavorably. Commissioner Bowes of Portland, Ore., reporting on his experience with the collection of sewer user service charges states: "There have been surprisingly few objections to paying this charge (probably much less than a quarter of one percent). A large proportion of these objections were occasioned by the fact that the first bills received by the objectors were for a period of four or more months with their regular quarterly water bills.

"Finding that it is impracticable to comply with the exact wording of the ordinance authorizing the collection of this sewer user service charge which requires that the water be metered where it 'enters the sewer,' the charge is made for the amount of water leaving the city mains, modified by sub-metering such water as is exempt from the charge or is charged at a lower rate than standard.

"Water pumped from the river or from wells is measured by meters installed at the expense of the owners of such pumps and is subject to the same sewer user service charge as though it were bought from the city."

COPPER AND DIGESTION—Poisons such as copper are known to have deleterious effects on biological processes, but the insidious nature of the effect of small amounts of copper in sewage upon the decreased efficiency of the operation of sludge digestion has not been generally recognized. A plant may be operating with a normal gas production and reduction of volatile matter, but require a longer period for the development and completion of digestion than would be possible if a plant is to be operated at full capacity. Hoover, (*Eighth Biennial Report*, Connecticut Water Comm.) has observed in experiments the remarkable increase or concentration of copper in settled sludge, obtained from relatively small traces of copper in the sewage.

For example, a sewage containing 0.5 ppm of copper was found to produce a sludge containing 100 ppm. It was also found that the nature of the chemical compound of the copper precipitated in the sludge is important in its effect on sludge digestion. The nature of this compound can be controlled by simple changes in the operation of the sewage plant. In general, when the amount of copper in sewage exceeds 1 ppm a decrease in efficiency of sludge digestion is observed. It appears that the proper control of copper and other metals by a small amount of a soluble sulfide aids in the elimination of harmful effects, when copper is present in amounts up to 1.25 ppm. If present in larger amounts it should be traced to the industry and reduced by treatment at its source. Suggested treatments include the use of scrap iron filters with acid wastes, and sodium or calcium sulfides followed by copperas with alkaline wastes.

TRADE WASTE AND DIGESTION—Treating domestic sewage and trade wastes at the Joint Rahway Valley disposal works has resulted in considerable difficulties with the two-stage sludge digestion process. The wastes are primarily acids, in addition to containing some alkalis and poisons. Fontenelli, the plant superintendent, reports that a gradual dropping off of daily gas production followed a decrease in the pH values of the settled sludge in the clarifiers. The solids pumped to the digesters reached a pH value of about 5.2, while composited samples of sewage ran at 6.7 instead of the normal 7.3–7.5. Gas production dropped from 75,000 to as low as 10,000 cu.ft. a day. Large quantities of lime were added, but the cost became an important factor.

To overcome the difficulties sludge from the primary tanks was pumped to a storage basin and a quantity of secondary sludge fed to the primary tanks. This seed material was thoroughly mixed and allowed to rest for 3 days. The secondary digesters were used as single-stage digesters, whereby gas production could be kept at about 40,000 cu.ft. a day. A proper relation between fresh solids and ripe sludge was maintained. The primary tanks were gradually brought back into operation by adding small quantities of settled sludge, allowing the concentration of the solids to increase. Where previously the sludge in the digesters remained between 4 and 5 percent solids, the concentration increased to 7 to 8 percent.

Present practice is to determine the amount of fresh settled solids in pounds of dry volatile solids; periodic determination of ripe sludge by sampling the digesters at one-foot level differences and maintaining optimum pH and temperature. Arrangements are being made with the principal industries to equalize and neutralize the wastes.

HISTORY—The great sewer of Rome is often cited as an early example of water carrying waste from the city. Wishart, speaking before the Institution of Sanitary Engineers, quoted a poem by John Lydgate, published in the 14th century and describing the rebuilding of Troy by Priam. The entire poem gives an excellent description of the way in which the River Xanctus flowed through the town and was used to carry away the discharges from the sewerage system. A few lines are given to indicate the character:

"And every hous cured was with led;
And many gargoyl and many hideous hed
With spoutis thorugh and pipes as thei ought,
From the ston-werke to the canel raught,
Voyding filthes low in-to the grounde,
Thorugh gratis percid of yren percid rounde

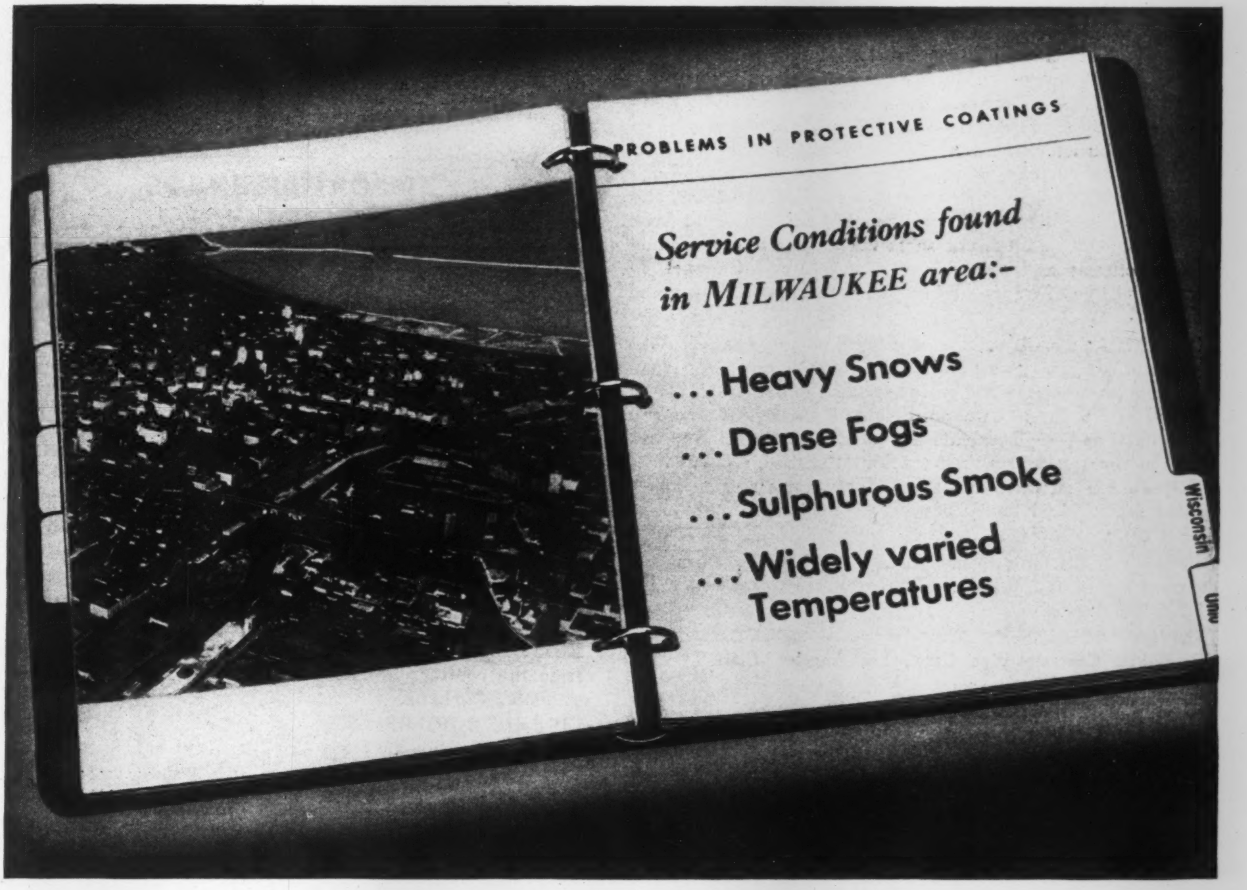
And thorugh this toun, so riche and excellent,
In the myddes a large river went.

By certeyn meanis artifical,
That it made a ful purgacioun
Of al ordure and fylthes in the toun,
Waschyng the stretys as thei stod a rowe,
And the goteris in the erthe lowe,
That in the cit was no filthe sene;

Wern born a-wey by course of the ryver
So covertly every thing was cured
Wher-by the toun was outterly assured
From engenderying of al corrupscioun,
From wikked eyr and from infeccioun,
That causyn ofte by her violence
Mortalite and gret pestilence."

ANOTHER PAGE IN THE STORY OF "BAKELITE" RESIN COATINGS

and how they meet rigid government and industrial specifications the country over



PROBLEMS IN PROTECTIVE COATINGS

Service Conditions found in MILWAUKEE area:-

...Heavy Snows

...Dense Fogs

...Sulphurous Smoke

...Widely varied Temperatures

THROUGHOUT the State of Wisconsin, protective finishes are subjected to extreme cold and heavy snows in winter, as well as excessively hot and rainy spells in summer. In Milwaukee are found still other conditions detrimental to paint performance. Here, dense fogs from Lake Michigan, sulphurous smoke from busy railroad yards, and fumes from vessels plying the surrounding waterways are important factors governing the proper selection of protective coatings.

To meet successfully these severe service conditions, leading paint and varnish manufacturers now supply primers and topcoats *fortified* with BAKELITE Resins. These durable, anti-corrosive finishes are exceptionally resistant to moisture, heat, and cold, and to the acid and alkaline atmospheres of industrial centers.

Used by Federal, State, Municipal, and Industrial Authorities the country over, BAKELITE Resin Coatings provide maximum surface protection for steel and other structures.

Let BAKELITE Laboratories assist you in formulating specifications that will insure greater durability for the finishes *you* require. Write for Booklet 11S, "BAKELITE Synthetic Resins," and Technical Bulletin 17, "Specifications for BAKELITE Resin Finishes."

BAKELITE CORPORATION, 30 EAST 42ND ST., NEW YORK
Unit of Union Carbide and Carbon Corporation

UCC

BAKELITE
TRADE MARKS

The word "Bakelite" and the identifying products
Symbol are registered trade-marks of Bakelite Corporation

Resins for Protective Coatings

CONTRACT UNIT PRICES

What contractors are bidding on different kinds of construction work

RIVER IMPROVEMENT LOS ANGELES, CALIF.

OWNER: U. S. Engineer Office, Los Angeles, Calif.; Lt. Col. E. C. Kelton, district engineer.

PROJECT: Constructing approximately 7,087 linear feet of improved river channel from River Mile 15.3 to 16.6 along Los Angeles River east of Maywood in adjacent unincorporated area of Los Angeles County. Work involves care of water and drainage during construction; clearing site and removal of existing obstructions; excavation and backfill for channel and structures; placing subgrade for railroad; raising railroad track; furnishing and driving steel sheet piles, test piles, and treated timber piles; bridge sub- and superstructures; rock fill and paving; plant-mixed surfacing; concrete for channel and structures; and side drainage structures. Channel, in general, will be of trapezoidal section with grouted rock paved slopes.

CONDITIONS: All work, except berm paving, channel fencing, Riverside Dr. paving and other work outside river channel, to be completed in 210 calendar days; entire project to be finished in 270 days. Owner will furnish all cement, and also all ballast and replacements for damaged ties and spikes required for raising railroad tracks. Railroad and highway transportation facilities available. Wage rates specified are: skilled labor, $1.00 to $1.50 per hr.; semi-skilled, 62½c. to $1.00; common, 62½ to 75c.

BIDS: Six bids were opened April 2, 1941, ranging from the contract low of $1,150,436 to $1,497,560. Engineer's estimate, $1,296,508.

LIST OF BIDDERS:

1. United Concrete Pipe Corp., Los Angeles, Calif. (contract)	$1,150,436
2. Winston Bros. Co., Los Angeles, Calif.	1,295,091
3. V. Bressi, Constructor, Los Angeles, Calif.	1,328,796
4. Floyd Shofner, Los Angeles, Calif.	1,348,131
5. Clyde W. Wood, Los Angeles, Calif.	1,394,939
6. Mittry Bros. Constr. Co., Los Angeles, Calif.	1,497,560

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Remove exist. round wood piles	850 ea.	$2.00	$3.85	$2.00
2. Remove exist. pavement	16,800 s. y.	.60	.08	.12
3. Remove exist. structures	L. S.	10,000.00	7,750.00	5,100.00
4. Remove L. A. Jct. R. R. bridge	L. S.	5,000.00	5,375.00	1,000.00
5. Remove Slauson Ave. Hwy. bridge	L. S.	10,000.00	12,000.00	4,000.00
6. Remove Pac. Elec. Ry. bridge	L. S.	5,000.00	4,500.00	2,000.00
7. Channel excavation	203,500 c. y.	.25	.40	.30
8. Toe excavation	84,000 c. y.	.25	.40	.30
9. Structure excavation	11,500 c. y.	1.30	1.35	3.00
10. Backfill and fill, uncompacted	35,000 c. y.	.10	.12	.15
11. Backfill and fill, compacted	214,000 c. y.	.12	.24	.18
12. Sheet steel piling	47,600 s. f.	1.10	1.05	1.25
13. Test piles	11 ea.	100.00	200.00	150.00
14. Treated timber piling	22,000 l. f.	1.00	1.55	1.40
15. Concrete; 8-in. pavement	6,100 s. y.	1.20	3.00	1.20
16. Conc.; invert slab, parapet walls, and footings for walls, piers, abutments	5,970 c. y.	5.16	6.50	6.65
17. Concrete; bridge superstruct	865 c. y.	16.00	27.00	32.00
18. Conc.; br. piers and abutments	1,510 c. y.	12.00	14.25	18.50
19. Concrete; retain. walls and curbs	2,120 c. y.	14.00	16.20	19.50
20. Conc.; for grouting derrick stone	12,200 c. y.	3.60	4.10	4.90
21. Concrete; slope paving toe	2,700 c. y.	4.00	5.65	7.15
22. Conc.; side drainage and misc. struct	510 c. y.	15.00	18.50	30.00
23. Steel reinforcement	1,440,000 lb.	.038	.041	.045
24. 12-in. grouted rock paving	8,150 sq.	25.00	30.00	26.50
25. Cr. gravel or cr. rock backing	22,800 c. y.	1.60	1.50	1.80
26. Derrick stone, 1 — 3-ton class, toe protection	55,800 c. y.	3.60	3.25	4.00
27. Derrick stone, 1 — 7-ton class, rock apron	2,300 c. y.	3.50	3.70	4.00
28. Quarry run rock; toe protection	3,200 c. y.	2.50	1.40	4.00
29. Plant-mixed surfacing	23,400 s. y.	.50	.70	.70
30. 6-in. decomposed granite base	1,350 c. y.	1.50	3.00	1.60
31. 4-in. asphaltic conc. paving	1,900 s. y.	.60	.60	1.00
32. 6-in. asphaltic conc. paving	5,700 s. y.	.80	.80	1.20
33. Expansion joint sleeves	2,930 ea.	.40	.45	.10
34. 6-in. vitr. clay sewer pipe	350 l. f.	.40	1.50	2.00
35. 8-in. vitr. clay sewer pipe	550 l. f.	.50	2.00	2.00
36. 8 x 6-in. vitr. clay sewer pipe wyes	19 ea.	2.00	2.00	10.00
37. Manhole constr. and reconstr	L. S.	500.00	600.00	750.00
38. 18-in. corr. metal pipe	67 l. f.	3.00	3.50	3.00
39. 24-in. corr. metal pipe	54 l. f.	4.00	6.00	4.00
40. 30-in. corr. metal pipe	352 l. f.	5.50	7.00	7.00
41. 48-in. corr. metal pipe	57 l. f.	12.00	16.00	15.00
42. 18-in. automatic drainage gate	1 ea.	60.00	60.00	50.00
43. 24-in. automatic drainage gate	1 ea.	80.00	85.00	100.00
44. 30-in. automatic drainage gate	6 ea.	120.00	130.00	120.00
45. 48-in. automatic drainage gate	1 ea.	300.00	340.00	200.00
46. Channel fencing	6,285 l. f.	.40	.40	.40
47. Miscellaneous metals	4,500 lb.	.20	.20	.20
48. Bridge steel; Slauson Ave. Br	1,115,000 lb.	.10	.106	.10
49. Bridge steel; Pac. Elec. Ry. Br	925,000 lb.	.085	.0875	.085
50. Steel bridge railing	1,015 l. f.	6.00	6.40	6.00
51. Track raising	3,560 l. f.	5.00	.40	4.50

AIRPORT DRAINAGE MORRISTOWN, N. J.

OWNER: U. S. Engineer Office, New York, N. Y., functioning as deputy contracting officer for Civil Aeronautics Administration.

PROJECT: All work required for the first stage of construction of Morristown, N. J., airport. Involves clearing and grubbing, general excavation, stockpiling topsoil, placing random embankment, and settling embankment by blasting; placing selected pervious embankment and humus on top, shoulders and slopes of random fill embankment; and excavating drainage ditches and placing culvert pipe and manholes.

CONDITIONS: Contractor to furnish all materials and complete work in 90 days. Highway and railroad transportation facilities available. Wage minimums specified are: skilled labor, $1.25 to $2.00 per hr.; semi-skilled, $1.00 to $1.25; and common, $1.00.

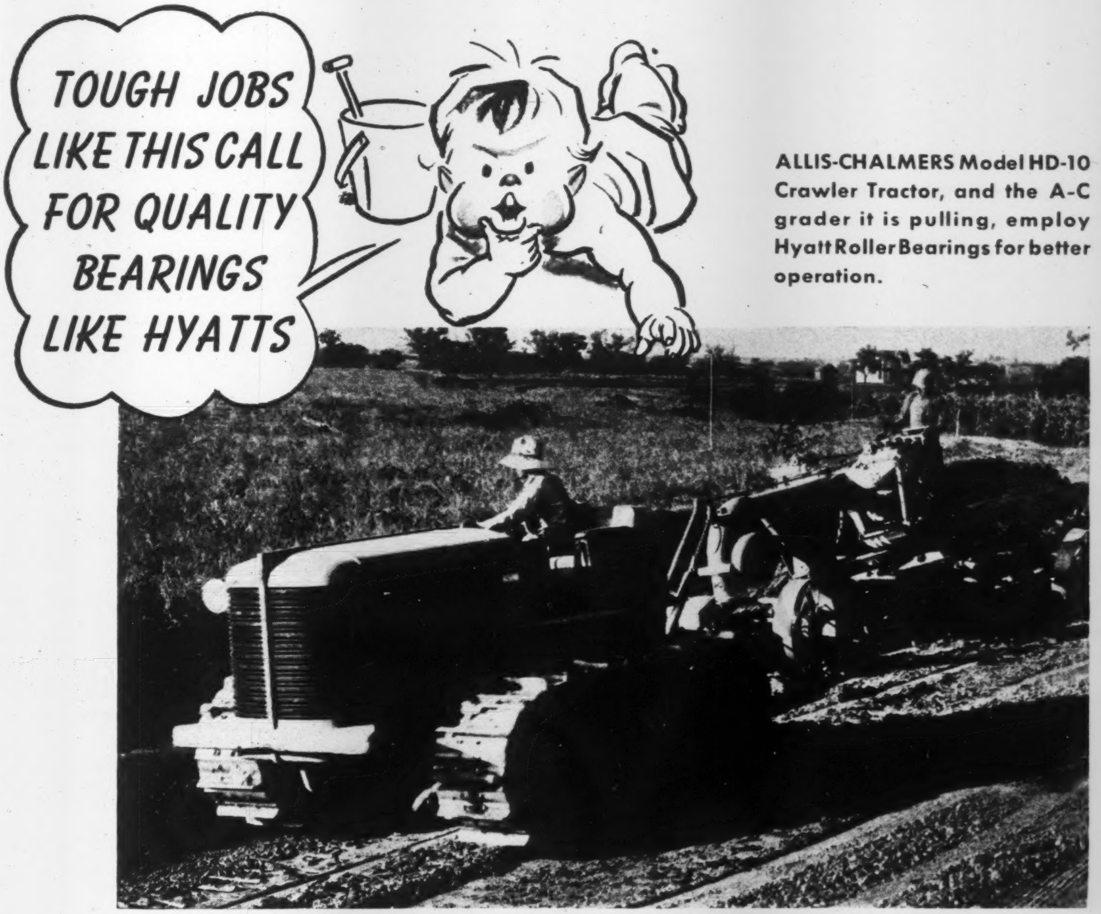
BIDS: Eighteen bids were opened March 20, 1941, ranging from the contract low of $265,872 to $1,121,657. Engineer's estimate, $264,268.

LIST OF BIDDERS:

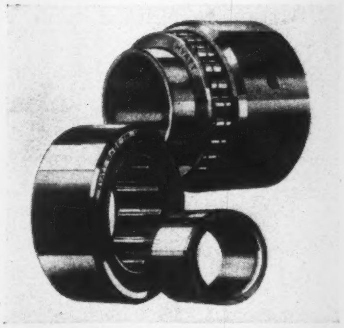
1. Joseph L. Sigretto & Sons, Inc., Carlstadt, N. J. (contract)	$265,872
2. N. D. Maselli Corp., Bloomfield, Conn.	266,885
3. Santaniello Bros., Jersey City, N. J.	313,152
4. United Crane & Shovel Service Co., Newark, N. J.	316,944
5. George M. Brewster & Son, Inc., Bogota, N. J.	358,016
6. S. J. Groves & Sons Co., Ridgefield, N. J.	360,714
7. Tully & Di Napoli, Inc., Long Island City, N. Y.	361,000
8. J. P. Burns, Dumont, N. J.	372,580
9. Franklin Contracting Co., Newark, N. J.	375,684
10. Villa Contracting Co., Westfield, N. J.	379,969
11. M. J. Roth, Flushing, N. Y.	384,640
12. Hendrickson Bros., Valley Stream, N. Y.	398,127
13. Circle Construction Co., White Plains, N. Y.	410,256
14. Andrew Gull Corp., New York, N. Y.	422,007
15. B. Perini & Sons, Inc., Framingham, Mass.	544,111
16. Frank Mashuda Co., Milwaukee, Wis.	555,000
17. Welch Bros. Contracting Co., Inc., Long Island City, N. Y.	594,100
18. Anthony Grasso, Newark, N. J.	1,121,657

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Clearing and grubbing	L.S.	$9,000.00	$40,000.00	$10,000.00
2. Excavation, topsoil	55,000 c. y.	.21	.18	.20
3. Excavation, common	144,000 c. y.	.21	.18	.20
4. Embankment, random	750,000 c. y.	.21	.16	.24
5. Embankment, selected pervious	77,300 c. y.	.24	.30	.30
6. Embankment, blending gravel (optional)	10,000 c. y.	.35	.35	.30
7. Dynamite for embankment, settlement (optional)	50,000 lb.	.30	.10	.15
8. Remove, reset structures	L.S.	1,200.00	15,000.00	800.00
9. Embankment, humus	329,000 s. y.	.04	.035	.10
10. Drainage ditches	19,600 l. f.	.20	.35	.72
11. Culvert pipe and manholes	L.S.	2,250.00	6,000.00	1,850.00

KEEP THEM YOUNG WITH HYATTS



ALLIS-CHALMERS Model HD-10 Crawler Tractor, and the A-C grader it is pulling, employ Hyatt Roller Bearings for better operation.



BUILT TO TAKE IT Hyatt Roller Bearings are found in the toughest assignments! And where bearing precision as well as bearing capacity is vital, you'll find Hyatts just as extensively used. That's what we mean by Hyatt Quality — correctness of design and accuracy of manufacture to meet bearing applications of every description. Hyatt Bearings Division, General Motors Sales Corporation, Harrison, N. J., Chicago, Pittsburgh, Detroit and San Francisco.

HYATT

ROLLER BEARINGS

QUIET

MATERIALS AND LABOR PRICES

Market quotations on construction materials and wage rates reported monthly by ENR correspondents

INCREASES in common and skilled wage rates provide the most important change in the construction material and labor price list for the third consecutive month. Bricklayers' rates are up 12½c. from the $1.25 level that formerly prevailed in both Atlanta and Los Angeles. Carpenters' wage in Detroit which was still being negotiated last month, has been set at $1.40 per hour, an increase of 15c. over the old rate, but 10c. lower than the preliminary wage agreement reported in May. Plasterers' rates are up 5c. per hour in Detroit, and are 6.7c. higher in San Francisco.

Common labor, both on buildings and heavy construction, is up 2c. per hour in Los Angeles, and is 5c. higher in Minneapolis. The new rate for common labor on heavy construction in New York is 95c. per hour, and it is 85 to 87½c. in San Francisco.

Lumber prices are mixed, pine is lower in Atlanta, New York and St. Louis, but Douglas fir prices are up in Boston, Chicago, New York, and San Francisco.

Cement prices are unchanged from a month ago, except in Montreal, and structural steel shapes remain the same as in May. Reinforcing bars are 15c. per 100-lb. higher in San Francisco. Structural rivet base price rose 35c. per 100-lb.

An 8 percent Dominion and Province sales tax has boosted Montreal building material prices all through the list.

CEMENT, AGGREGATES, READY-MIXED CONCRETE—F.O.B. CITY

	PORTLAND CEMENT Per bbl., carload lots, including 40c per bbl. for bags, cash discount not deducted			SAND AND GRAVEL Per ton, carload lots			CRUSHED STONE Per ton, carload lots		CRUSHED SLAG Per ton, carload lots, f.o.b. plant		CONCRETE Ready Mixed 1:2:4, 50 c.y. or more, delivered
	Cloth Bags *a*	Paper Bags	Bulk	Gravel, 1½ in.	Gravel, ¾ in.	Sand	1½ in.	¾ in.	1½ in.	¾ in.	
Atlanta	$2.90	$2.66	$2.61	$1.75	$1.85	$1.95	$1.75	$1.85	$1.55	$1.65	$7.90
Baltimore	2.36	2.11	1.91	1.75‡	1.75‡	1.25‡	1.75‡	1.75‡	1.75‡	1.75‡	6.75
Birmingham	2.50	2.25	2.05	1.75	1.75	1.50	1.00	1.00	.90	1.15	5.80
Boston	2.75*b*	2.50*b*	2.30	1.20‡	1.20‡	.90‡	1.20‡	1.20‡	....	....	6.75*m*
Chicago	2.60	2.35	2.20	2.00‡*d*	2.00‡*d*	2.00‡*d*	2.00‡*d*	2.00‡*d*	1.25‡	1.25‡	....
Cincinnati	2.31	2.06	1.81	1.20	1.20	1.10	1.80	1.80	....	....	6.30
Cleveland	2.00	1.75	....	1.45*i*	1.45*i*	1.30*i*	1.70*i*	1.70*i*	1.70*i*	1.70*i*	6.55*i*
Dallas	2.47	2.22	2.02	1.75*p*	2.00*p*	1.25*p*	1.69*p*	1.84*p*	....	....	6.20
Denver	3.08	2.83	....	1.20	1.40	.90	....	....	....	....	7.25
Detroit	2.24	1.99	1.79	1.31	1.41	.91	1.50	1.50	1.65‡	1.65‡	6.50
Kansas City	2.56	2.31	2.16	1.85	2.30	1.00	1.91	1.91	....	....	7.25*n*
Los Angeles	2.25*b*	2.05*b*	....	1.00	1.00	1.00	1.00*f*	1.00*f*	....	....	5.85
Minneapolis	2.90	2.65	....	1.00*h*	1.00*h*	.25*h*	1.00*h*	1.00*h*	....	....	7.35*j*
Montreal	....	1.95*rs*	1.79*rs*	....	....	1.25‡*t*	.85‡*ct*	1.00‡*ct*	....	....	6.45*ls*
New Orleans	2.41	2.16	1.96	1.50	1.50	1.25	....	....	....	....	7.25
New York	2.55‡	2.30‡	....	1.50*de*	1.50*de*	.90*de*	1.65*de*	1.75*de*	....	....	6.50
Philadelphia	2.32	2.07	1.87	1.55‡	1.65‡	1.25‡	....	....	1.00	1.00	7.95*k*
Pittsburgh	2.44	2.19	1.99	1.40‡	1.40‡	1.70‡	2.25‡	2.25‡	1.50	1.50	7.50
St. Louis	2.55	2.30	....	1.50‡	1.50‡	1.25/1.50‡	1.10*h*	1.10*h*	.75*g*	.75*g*	7.75
San Francisco	2.16	1.96	1.66	1.36	1.36	1.36	1.46	1.46	....	....	6.95
Seattle	2.95*o*	2.70*o*	....	1.00*o*	1.00*o*	1.00*o*	2.00*o*	2.00*o*	....	....	7.25

‡ Delivered. *a* 10c. allowed for each returnable bag. *b* 10c. per bbl. off for cash. *c* Plus municipal tax. *d* Per cu. yd. *e* Barge lots alongside docks. *f* Crushed granite. *g* F.o.b. Granite City, Ill. *h* F.o.b. plant. *i* Within three miles of Public Square. *j* 5% discount for cash. *k* Discount 35c. 500 to 2000; 70c. 2000 to 5000; 95c. over 5000. *l* Up to 200cu. yd. *m* 50c. off for cash. *n* 25 c.y. or more. *o* 2% off for cash. *p* 10c. per ton off, cash 15 days. *r* 10c. per bbl. off, cash 20 days. *s* 8% sales tax included. *t* 8% sales tax not included.

CASH DISCOUNTS CEMENT to Contractors: truck delivery. 2% for cash on 10th of month; on carload deliveries, no trucking, same as dealer cash discount 10c. per bbl. for payment within 15 days of date of invoice. Subject discount 10c per bbl. 20 days in Montreal.

CURRENT MAXIMUM PRICES RECEIVED AT CEMENT MILL

Charge for bags not included. For cloth bags, add 40c. per bbl.; 10c. refund allowed for each returnable bag; for paper bags add 15c. per bbl., not refundable.

	Bagged	Bulk		Bagged	Bulk		Bagged	Bulk
Buffington, Ind.	$1.70	$1.65	Ironton, Ohio	$1.60	$1.55	Richard City, Tenn.	$1.80	$1 75
Dallas, Tex. (Inc. 10c. tax)	1.85	1.80	Limedale, Ind.	1.70	1.65	Steelton, Minn.	1.80	1.75
Hannibal, Mo.	1.70	1.65	Norfolk, Va.	1.65	1.60	Universal, Pa.	1.65	1.60
Hudson, N. Y.	1.75	1.70	Northampton, Pa.	1.55	1.50	Waco, Tex (10c. tax in Tex.)	1.75	1.70
Independence, Kans.	1.70	1.65	North Birmingham, Ala.	1.70	1.65	Montreal (8% sales tax incl.)	1.68	1.67

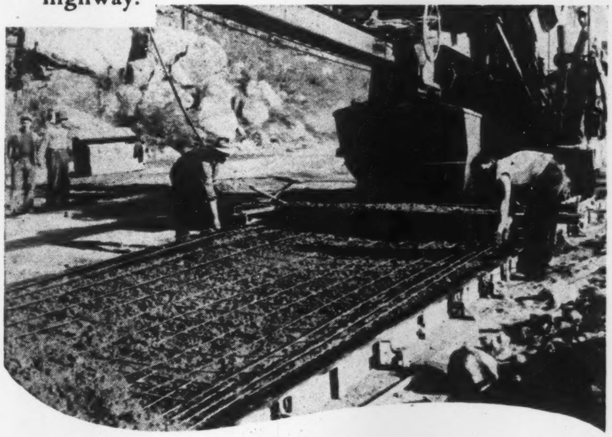
PAVING BRICK, BLOCKS, ASPHALT, ROAD OILS—F.O.B. CITY

	PAVING BRICKS AND BLOCKS			PAVING ASPHALT Per ton, less than 80 penetration		ASPHALT BINDERS—FLUXES Per gal., 80 300 penetration		CUTBACK ASPHALT Per ton		ROAD OILS Per gal.	ASPHALT EMULSION (Quick-breaking) Per gal.	
	Granite per M. lots of 50,000 4x4x8 in.	Brick per M. 3x4x8½ in. carload lots	Wood per sq. yd. 3½ in. 16-lb. treat	Tank car	Drums	Tank car	Drums	Tank car	Drums	Tank car	Tank car	Drums
Atlanta	$73.00	$39.35	$2.25	$17.30*e*	$23.83*e*	$0.0695*e*	$0.1018*e*	$0.0734*he*	$0.1257*h*	$0.0634*e*	$0.0734	$0.1257
Baltimore	165.00‡	45.00‡	2.90	14.00	20.00	.06	.09	.065*h*	.115*h*	......	......	......
Birmingham	......	27.50*j*‡	....	18.20	23.20	.0747	.1047	.0834*h*	.1484*h*	......	......	......
Boston	90.00	47.50	3.25	14.00	20.00	.06	.09	.065*h*	.115*h*	.065	.09‡	.12‡
Chicago	150.00	50.00	1.85*d*	14.50	18.50	14.00*g*	18.00*g*	.06*h*	.10*h*	.05	.09	.125
Cincinnati	112.00	37.50	....	14.00	18.00	.08	......	16.80	......	.0625	......	.085
Cleveland	110.00	37.50	2.25	15.00	20.00	.065	.075	.075*h*	.085*h*	.035	.08	.09
Dallas	......	30.00	....	13.25	20.30	.06	.103	15.00	24.80	.055	.05/.07	.07/.09
Denver	......	27.50	....	.....	.....	......	......	......	......	......	......	......
Detroit	......	35.00	....	14.10*f*	19.00*f*	.061	.1025	14.10	18.60	.0425	.0645	.098
Kansas City	......	40.00	....	18.50	23.50	.077	.1075	.077*h*	.107*h*	.057	.11	.15
Los Angeles	......	50.00	....	6.50*b*	15.00	6.50*bg*	15.00*bg*	5.50*b*	......	.0192	.0525	.1125
Minneapolis	......	......	1.90*d*	21.20	25.70	.10	.12	19.00	29.50	.06	......	......
Montreal	75.00*k*	......	3.62*k*	16.60*k*	24.25*k*	.116*k*	.1483*k*	.115*hk*	.135*hk*	.08*k*	.135*k*	.188*k*
New Orleans	......	......	....	14.00*a*	19.00*a*	.055	.085	.06*h*	.09*h*	......	.078	......
New York	......	......	2.90	15.00	21.00	.06	.09	.065*h*	.115*h*	......	.07	.11
Philadelphia	120.00	42.50	2.84	14.00	20.00	.055	.095	.06*h*	.10*h*	.05	.06	.10
Pittsburgh	135.00	38.75	....	.....	.....	......	......	......	......	......	......	......
St. Louis	115.00/125.00	37.00	....	14.00	19.00	14.00*g*	18.00*g*	.06*h*	.095*h*	.0425	.09	.125
San Francisco	......	70.00	....	6.50	15.00	6.50*g*	15.00*g*	7.00	17.50	.025	.0525	.1125
Seattle	......	60.00*c*	....	15.70	24.10	......	24.10*g*	10.50/11.50	24.00/25.00	8.75*g*	.0575*i*	.1308*i*

‡ Delivered. *a* F.o.b. Baton Rouge. *b* Delivered to purchaser's warehouse. *c* 3½x4x8½ in. *d* 2½ in. 6 to 8-lb. treatment. *e* Local reduction due to 20% reduction intra-state class freight rates, only Georgia affected. *f* Mexican *g* Per ton. *h* Per gallon. *i* F.o.b. Martines. *j* 3x3⅝x8½ in. *k* tax included

Another Famous Highway USES Pittsburgh Reinforcement

New York's Storm King Highway has been called "the most beautiful roadway in the world." Photograph above shows *Pittsburgh Reinforcement* being laid on one section of the relocated and repaved highway.



The stress of modern traffic loads is safely distributed over the entire slab area through the welded wire network of *Pittsburgh Reinforcement.*

Again, Welded Wire Reinforcement was chosen to help make one of the world's most scenic highways *safer* and more *permanent.*

Any modern concrete highway laid with *Pittsburgh Reinforcement* is "bound to be a better road." For, through the *embedment* of this high tensile welded steel mesh, the concrete is *bound* into integrated slabs of tremendous strength with greater load distributing qualities. Incipient cracking is controlled from the start . . . prolonging life and reducing maintenance expense.

Join the increasing group of state, county and municipal authorities who insist on *Pittsburgh Reinforced* concrete roads. Information on request.

PITTSBURGH STEEL COMPANY
1662 GRANT BLDG., PITTSBURGH, PA.

Pittsburgh Reinforcement

IRON AND STEEL PRODUCTS—BASE MILL PRICES

	STRUCT. SHAPES-PLATE	REINF. BARS ¾-in. billet b	RIVETS ⅞-in. structural	WIRE NAILS Base d	SHEET PILING Base	STEEL RAILS Per Gross Ton Standard	Light	Re-rolled	TRACK SUPPLIES Angle Bars	Std. Spikes c	Tie Plates c	Track Bolts
Birmingham	$2.10	$2.15	$3.75	$2.55	.....	$40.00	$40.00	$39.00	$2.70	$3.00	$2.15	$4.15
Chicago	2.10	2.15	3.75	2.55	$2.40	40.00	40.00	39.00	2.70	3.00	2.15	4.15
Pittsburgh	2.10	2.15	3.75	2.55	2.40	40.00	40.00	39.00	2.70	3.00	2.15	4.15
Buffalo	2.10	2.15	.....	.....	2.40	.....	.....	.....	.....	.....	2.15	...
Cleveland	2.10	2.15	3.75	2.55	.....	.....	.....	.....	.....	.....	.....	...
Youngstown	.....	2.15	.....	.....	.....	.....	.....	.....	.....	3.00	.....	.....
Detroit	...	2.25‡	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Gulf ports	2.45a	2.50a	.....	.....	2.85a	.....	.....	.....	.....	.....	.....	.....
Pacific ports	2.75a	2.60a	.....	.....	2.95a	.....	.....	.....	.....	.....	2.30	.....

‡ Delivered. a F.o.b. cars dock. b Rail steel same as billet prices. c Other basing points include Portsmouth, O., Weirton, W. Va., St. Louis, Kansas City, Minnequa, Colo., and Pacific coast ports, on tie plates, alone, Steelton, Pa., on spikes alone, Lebanon, Pa., Richmond, Va. d Add switching charge $18 per c.l.

IRON AND STEEL PRODUCTS—F.O.B. WAREHOUSE, PER 100 LB., BASE PRICE

	STRUCTURAL SHAPES Per 100 lb. base price	REINFORCING BARS* Per 100 lb., ¾ in., base price 15 tons or over b New billet	Rail steel	Add Switch	$/cwt. for Del.	EXPANDED METAL LATH —Per 100 sq.yd., carload lots— Std. diamond mesh, 3.4 lb.	Std. ribbed 3.4 lb.	WELDED FABRIC REINFORCING —Per 100 s.f., carload lots— 4x16 in., No. 5 & 10 wires	4x12 in., No. 8 & 12 wires	6x6 in. No. 6 & 6 wires Per sq. yd.	SHEET PILING Per 100 lb. base price
Atlanta	$2.34	$2.39	$2.39	.02½	.10	$21.00	$23.00	$1.82	$1.35	$0.1719	$3.04
Baltimore	3.70	2.90	2.75	......	.10	26.00	28.00	1.70	1.27	.1611	3.00
Birmingham	2.10a	2.15	2.15	.02½	.10	19.00	22.50	1.80	1.34	.1701	....
Boston	3.75	2.61	2.51	$20 C.L.	.10	15.50	17.50	1.76	1.31	.1656	2.77
Chicago	2.10a	2.15	2.05	.03	.05	20.50	22.50	1.67	1.25	.1575	2.40
Cincinnati	3.68	2.51cd	2.41cd	......	.05	19.50	21.50	1.66	1.25	.1566	....
Cleveland	3.58g	2.15	2.15	.02½	.10	19.50	21.50	1.66	1.25	.1566	....
Dallas	5.30	3.95	3.95	......	.....	23.50	25.50	1.93	1.42	.1827	....
Denver	4.35	3.95	3.80	......	.....	24.50	26.50	1.97	1.45	.1863	....
Detroit	3.65‡	2.25	2.15	......	.10	22.50	24.50	1.68	1.26	.1584	2.66
Kansas City	4.00	2.51cd	2.36cd	.0	.05	17.50	21.00	1.78	1.33	.1683	2.86
Los Angeles	3.65f	2.25	2.10	.02½	.05	23.00	27.50	1.93	1.42	.1827	3.65
Minneapolis	3.80‡	2.48c	2.48c	.0	.10	21.50/22.50	23.50/24.50	1.80	1.34	.1701	2.73d
Montreal	3.90i	2.65i	2.55i	......	.....	26.00hi	33.00hi	2.58i	3.22i	.264i	2.58i
New Orleans	4.40	2.52	2.52	.05	.10	21.50	23.50	1.82	1.35	.1719	2.875
New York	3.75	2.39	2.39	......	.15	18.50	20.50	1.76	1.32	.1665	2.74
Philadelphia	3.75	2.66	2.56	......	......	19.50	21.50	1.71	1.28	.1611	2.72
Pittsburgh	2.10a	2.15	2.15	.02½	.10	21.50	24.50	1.59	1.20	.1503	2.40
St. Louis	3.69	2.39	2.39	.0	.05	22.50	26.50	1.69	1.27	.1602	2.70
San Francisco	3.90	2.65	2.50	.02½	.10	19.00	25.50	1.93	1.42	.1827	3.25
Seattle	2.75e	2.50e	......	......	......	25.50	27.50	1.93	1.42	.1827	2.95e

‡ Delivered. a Mill prices. b 5–15 tons, add 15c. 1–5 tons, add 25c. Less than 1 ton, add 50c. c 20 tons or over Base. d Mill price plus freight. e F.o.b. dock. f Includes delivery in free delivery zone. g Less than 1 ton, add 25c.; 1 to 5 tons, add 10c. High scrap steel prices cut former 15c. differences between new billet and rail steel in many mills. h List price. i Plus Dominion and Province sales tax.

PLUMBING, HEATING, WATER, SEWER AND DRAIN PIPE

	C. I. PIPE Per net ton f.o.b. 6 in. to 24 in.a	VITRIFIED SEWER PIPE Per foot, std. 8 in., s.s.	delivered std. 12 in., s.s.	ASTM 24 in.,	C13–35 36 in.,	CLAY DRAIN TILE Per 1,000 ft., carload lots, f.o.b. 6 in.	8 in.	CONCRETE SEWER PIPE Per ft., delivered; ASTM 12 in.	C 14–35 24 in.	WROUGHT STEEL PIPE Full standard weight, h 1 to 3 in., Butt Weld Black %	Galv. %	3½ to 6in.; Lap Weld Black %	Galv. %
Atlanta	$49 40	$0.26b	$0.468bc	$1.8525	$4.68c	$85.00	$128.00	$0.45	$1.642	62.2	54.2	59.7	51.2
Baltimore	52.80	.45	.70	2.50	6.90	120.00	160.00	.75	2.00	65.5	57.5	63.0	54.5
Birmingham	45.00	.26	.468	1.7875	4.66	85.00	220.00	.40	1.60	62.2	54.2	59.7	51.2
Boston	55.00	.203	.4455	1.98	5.64	115.50‡	228.50‡	.45	1.69	64.1	56.1	61.6	53.1
Chicago	53.80	.28	.54	2.25	6.25	100.00‡	150.00‡	.38	1.48	67.0	59.0	63.5	55.0
Cincinnati	52.70	.196	.378	1.485	4.510	105.00	170.00	.60	1.70	65.9	57.9	63.4	54.9
Cleveland	54.24	.182	.351	1.395	4.305	69.00	108.00	.35	1.50	67.8	59.8	65.3	56.8
Dallas	58.20	.28	.504	2.016	4.70	80.00	100.00	.46	1.57	59.9	51.9	57.3	48.3
Denver	60.60	.24†	.52†	2.16†	......	130.00	240.00	....	....	58.4	50.4	55.7	47.2
Detroit	54.24	.245	.4725	1.935	4.408	66.45	105.00	.33	1.50	66.3	58.3	63.8	55.3
Kansas City	55.12	.30	.54	2.16	5.00	120.00	240.00	.45	1.60	62.9	54.9	60.0	51.5
Los Angeles	55.00	.282†	.508†	2.034†	5.085†	115.50	192.50	1.00	2.00	59.6	51.6	57.0	48.6
Minneapolis	57.20	.24†	.432†	1.728†	4.60†	......	......	.70	1.80	64.2	56.2	60.7	52.2
Montreal	60.00	.55	.90	3.68	5.95e	135.00‡	260.00‡	.48l	1.92l	......	......	......	....
New Orleans	51.38	.26	.48	1.69	......	150.00	220.00	.37	2.10	62.4	54.4	58.8	50.3
New York	52.20	.35	.66	2.60	6.70	......	......	.50	1.20	64.9	56.8	62.4	53.9i
Philadelphia	50.90	......	......	......	......	......	......	.54	1.80	65.3	57.3	62.8	54.3
Pittsburgh	55.60	.245†	.4725†	1.845†	5.4325	97.80	154.20	.85g	2.00g	68.5i	57.5i	66.0i	54.5
St. Louis	52.48	.24	.432	2.016	3.96	85.00	170.00	.75j	1.80k	65.1	57.1	62.0	53.5
San Francisco	55.00	.3275d	.5895d	2.358	5.895	107.25	178.75	.54	2.50	52.5	43.1	50.2	50.0
Seattle	55.35	.35	.63	2.52	6.30	72.00	175.00	.35f	1.30f	......	......	......	....

‡ Delivered. † F.o.b. a B. & S. class B and heavier, C/L lots, 200 tons and over Burlington, N.J. (base) $49.00. Gas pipe and class A, $3 per ton additional, 4 in., $3 per ton additional, 30 in. and larger usually $2 per ton less. b Double strength. c List to dealer. d List. e 30-inch. f Less 5% for cash. g Culvert pipe. h Discounts from standard list consumers carload prices, except Pittsburgh prices are f.o.b. mill. Base price $200 per net ton. List prices per ft.: ½ in., 8½c.; ¾ in., 11½c.; 1 in., 17c.; 2 in., 37c.; 2½ in., 58½c.; 3 in., 76½c.; 4 in., $1.09; 6 in., $1.92. i Applies also at Lorain, Ohio, mills. Chicago delivered base is 2½ points less on butt, 1½ on lap. Freight is figured from Pittsburgh, Lorain, O., Chicago Dist. Billing is from point producing lowest price at destination. WROUGHT IRON PIPE: Base price and list prices per ft. same as wrought steel pipe. Discount for Pittsburgh base: Butt-weld—1 in. and 1¼ in. black 34, galv. 16; 1½ in. black 38, galv. 18½; 2 in. black 37½, galv. 18. Lapweld—2½ in. to 3½ in. black 31½, galv. 14½ in.; 4½ in. to 8 in. black, 32½ galv. 17. j Reinforced; spec. C 76-37. k Reinforced; spec. C 75-37. l Plus sales tax.

ARMY CAMP CONSTRUCTION
with an Excavator that
• • MEANS BUSINESS

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BUCYRUS ERIE
37-B

L. E. DIXON CO., Contractors at Army Camp near San Luis Obispo, California, using a Bucyrus-Erie 37-B shovel on excavation work.

You'll find the 37-B means Business . . and *extra* profits . . whether you use it as shovel, dragline, clamshell, crane or dragshovel. A fast, heavy-duty machine, without a single pound of excess weight, the modern 37-B is designed and built to move dirt, plenty of it, and move it at bottom cost per yard.

Ask us to show you how it fits into your picture.

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SOUTH MILWAUKEE, WISCONSIN

LUMBER, TIMBER, PLYWOOD—PER M FT., B.M., CARLOAD LOTS F.O.B.

	SHORT LEAF YELLOW PINE AND DOUGLAS FIR All S. L. Y. P. is No. 2 common or better and for No. 1 N. C. Box. (Prices in Bold Face) *All Fir planks No. 2 common, Fir timber is No. 1 common. Lengths up to 20 ft. (Prices in italics)*									LONG LEAF Y. P. Merchantable grade up to 20 ft.		PLYWOOD* Rail freight increment (See note for base price)	
	1x6 S4S	1x8 S4S	2x4 S4S	2x6 S4S	2x8 S4S	2x10 S4S	3x12 Rgh	6x12 Rgh	12x12 Rgh	2x12 Rgh	12x12 Rgh	⅝"	¾"
Atlanta	**$21.00**	**$21.00**	**$20.00**	**$21.00**	**$21.50**	**$24.50**	**$27.00**	......	......	$40.00	$50.00	$17.75	$21.60
Baltimore	**41.00**	**42.00**	**40.00**	**41.00**	**41.00**	**44.00**	**55.00**	......	......	80.00	85.00	17.35g	21.15g
	43.00	*43.00*	*43.00*	*43.00*	*44.00*	*45.00*	*55.00*	*$57.00*	*$58.00*	......	......	......	......
Birmingham	**25.00**	**25.00**	**25.00**	**25.00**	**25.00**	**27.00**	**48.00**	**46.00**	**46.00**	......	......	16.25	19.85
[1]	30.00	30.00	29.00	29.00	30.00	35.00	55.00	......	......	58.00	58.00	......	......
Boston	40.00[2]	40.00[2]	40.00[3]	45.00	60.00[1]	65.00[1]	80.00[1]	......	......	80.00	80.00	17.35g	21.15
	40.00	*40.00*	*40.00*	*45.00*	*45.00*	*45.00*	*50.00*	*50.00*	*55.00*	......	......	......	......
Chicago	**42.00**	**42.00**	**39.00**	**39.00**	**39.00**	**43.00**	**52.00**	......	......	90.00	100.00	13.80	16.80
	40.00	*40.00*	*40.00*	*41.00*	*41.00*	*44.00*	*47.00*	*47.50*	*47.50*	......	......	......	......
Cincinnati	**37.50**	**39.00**	**38.00**	**38.00**	**38.00**	**41.00**	**50.00**	......	......	60.00	63.00	16.25	19.85
	......	......	......	......	......	......	*52.00*	*52.00*	*52.00*	......	......	......	......
Cleveland	**40.00**	**41.00**	**41.00**	**39.00**	**40.00**	**45.00**	**50.00**	50.00	50.00	83.00	83.00	16.70	20.40
Dallas *e*	**38.00**	**39.00**	**38.00**	**36.00**	**37.00**	**38.50**	**52.50**	**52.50**	**52.50**	76.00	81.00	13.90	16.95
Denver ‡	49.00[4]	47.00[4]	50.00[4]	50.00[4]	50.00[4]	52.00[4]	52.00[4]	62.00[4]	65.00[4]	......	......	9.90	12.05
Detroit	**42.50**	**42.50**	**41.00**	**42.50**	**42.50**	**44.50**	**51.00**	......	......	50.00	59.00	16.25	19.85
	......	......	......	......	......	*49.00*	*52.00*	*59.00*	*59.00*	......	......	......	......
Kansas City	**40.00**	**40.00**	**37.00**	**37.00**	**37.00**	**40.00**	**45.00**	......	......	65.00	70.00	12.25	14.95
	42.50	*42.50*	*40.00*	*40.00*	*40.00*	*42.50*	*42.00*	*45.00*	*45.00*	......	......	......	......
Los Angeles *a*	*40.00*	*40.00*	*39.00*	*39.00*	*36.00*	*36.00*	*43.00*	*48.00*	*43.00*	......	......	9.35*gh*	11.35*gh*
Minneapolis ‡*b*	40.00[6]	40.00[6]	......	......	......	......	......	......	......	......	......	12.05	14.70
‡	*42.00*	*42.00*	*42.00*	*40.00*	*40.00*	*42.00*	*46.00*	*53.50*	*53.50*	......	......	......	......
Montreal †[7]	*36.00*	*38.00*	*36.00*	*38.00*	*40.00*	46.00	......	......	......	155.00	165.00	......	......
	53.50	*53.50*	*54.25*	*54.25*	*59.25*	*59.25*	*65.00*	*65.00*	*65.00*	......	......	......	......
New Orleans	**24.00**	**25.00**	**25.00**	**24.00**	**24.00**	**25.00**	**46.00**	......	......	62.00	69.00	13.90	16.95
	29.00	*29.00*	*32.00*	*33.00*	*35.00*	*34.00*	*36.00*	......	......	......	......	......	......
New York ‡	**42.00**	**43.00**	**43.00**	**43.00**	**44.00**	**46.00**	**48.00**	......	......	85.00*f*	90.00*f*	17.35g	21.15g
‡	......	......	*54.00*	*54.00*	*54.00*	*54.00*	*54.00*	*60.00*	*60.00*	......	......	......	......
Philadelphia	**24.00**	**24.50**	**25.50**	**25.50**	**27.50**	**27.50**	**29.00**	......	......	50.00	57.50	17.35g	.1512g
	35.00	*36.50*	*39.00*	*38.25*	*29.00*	*39.00*	*44.00*	*32.00*	*32.00*	......	......	......	......
Pittsburgh	**50.80**	**53.20**	**62.75**	**55.00**	**60.85**	**62.50**	**76.25**	......	......	......	......	17.00	20.70
	69.20	*68.10*	*66.10*	*65.30*	*65.20*	*65.65*	*88.75*	*88.75*	*88.75*	......	......	......	......
St. Louis ‡*c*	**38.00**	**39.00**	**37.00**	**36.00**	**37.00**	**39.00**	**52.00**	*58.00*	*58.00*	76.00	75.00	13.90	16.95
San Francisco *d*	*32.00*	*31.00*	*32.00*	*33.50*	*33.00*	*33.50*	*33.50*	*32.00*	*32.00*	......	......	7.30g	8.90g
Seattle	*27.00*	*27.00*	*27.00*	*27.00*	*27.00*	*27.00*	*36.00*	*36.00*	*36.00*	......	......	0.00	0.00

Bold Face type, Southern Pine. *Italics, Douglas Fir.* [1] Long leaf. [2] Roofers' N. C. Pine. [3] Spruce. [4] Native. [6] Western Pine, No. 3 Common. [7] Spruce. [8]Norway Pine. ‡ Delivered. *a* Yard prices. *b* Contractors discount in Minneapolis and St. Paul discontinued May 21, 1938. *c* 5M ft. or less. *d* At ship's tackle. *e* 10% discount taken off. *f* Up to 18 ft. † Plus sales tax.

NOTE: Special concrete form grade Fir Plywood, 4′ by 8′ panels, 5-ply, sanded 2 sides, water resistant glue, carload lots, delivered per 1,000 sq. ft. surface. Seattle base price on ⅝", $86.50; on ¾", $95.30; price includes oiling and sealing charges. For other centers add rail freight increment from table or proper size. For resin dipped treatment, add $10.50 per M. *Many mills out of market due to rush of defense orders. *g* Lower rate by water shipment. *h* 50,000 lb. minimum

GLASS, EXPLOSIVES, CHEMICALS

	WINDOW GLASS Discounts from jobbers list, Aug. 15, 1938 Single or Double Thickness A quality	 B quality	EXPLOSIVES Per lb. 40% Ammonia Gelatin in 50-lb. cases delivered in 200 lb. lots*	
Atlanta	75%	75%	$0.15	Price of 60% Ammonia Gelatin is $0.015 per lb. higher than 40%
Baltimore	82%	81%	.15	
Birmingham	75%	75%	.105	
Boston	78%	79%	.15	
Chicago	79%	79%	.15	
Cincinnati	77%	77%	.15	
Cleveland	77%	77%	.19	
Dallas	78%	78%	.1625	
Denver	77%	77%	.155*e*	
Detroit	79–10%	79–10%	.15	
Kansas City	77–10%	77–10%	.155	
Los Angeles	86%*d*	88%*d*	.1575	
Minneapolis	76%	76%	.155	
Montreal	40–10%‡	50–5%‡	.155†	
New Orleans	70%	75%	.16	
New York	81%	82%	.22*f*	
Philadelphia	82–10%*d*	83–10%*d*	.15	
Pittsburgh	79%	79%	.1225	
St. Louis	77–10%	77–10%	.155	
San Francisco	78%*d*	83%*d*	.155	
Seattle	75%	76%	.1575†	

a Disc. from list Sept. 1939. *b* Also less 6% tax exemption. *d* Discount from jobbers' list Sept. 15, 1928. ‡ Plus sales tax.

* Urban prices influenced by service charges or local storage and delivery regulations, do not consistently reflect quantity prices in less congested areas. *e* F.o.b. Louviers, Colo. *f* In boroughs of Kings, Queens and Richmond, and in Manhattan south of Canal Street, add delivery charge of $6.00 per trip. † F.o.b.

40% Ammonia Gelatin price ranges in other than urban areas, per lb. (except Seismograph Grades)

	C/L 20,000 lb. net	Tons	200 lb. lots
E. of the Miss., except Fla	$0.105	$0.14	$0.16
W. of Miss. to Rocky Mtn. States, and Fla	.11 –.1175	.135 –.1475	.155 –.1675
Rocky Mtn. States	.105 –.1325	.125 –.1375‡	.135–.1525‡
Pacific N. W. States	.1075–.12	.1375–.15	.1575–.17
Pacific S. W. States	.1050–.1175	.135 –.1475	.155 –.1625

‡F.o.b. Louviers, Colo., or Butte, Mont.

PILES, TIES—F.O.B.

PILES

Prices per linear foot, pine, with bark on, f.o.b. New York; delivered from barge 1½ to 2c. per ft. additional:

Dimensions	Points	Length	Short Leaf Barge	 Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.22	$0.195
12 in.— 2 ft. from butt	6 in.	50 to 59 ft.	.26	.24
12 in.— 2 ft. from butt	6 in.	60 to 69 ft.	.28	.255
14 in.— 2 ft. from butt	6 in.	50 to 69 ft.	.30	.265
14 in.— 2 ft. from butt	6 in.	70 to 79 ft.	.36	.275
14 in.— 2 ft. from butt	5 in.	80 to 85 ft.	.42	.415
14 in.— 2 ft. from butt	5 in.	85 to 89 ft.	.45	.482

RAILWAY TIES

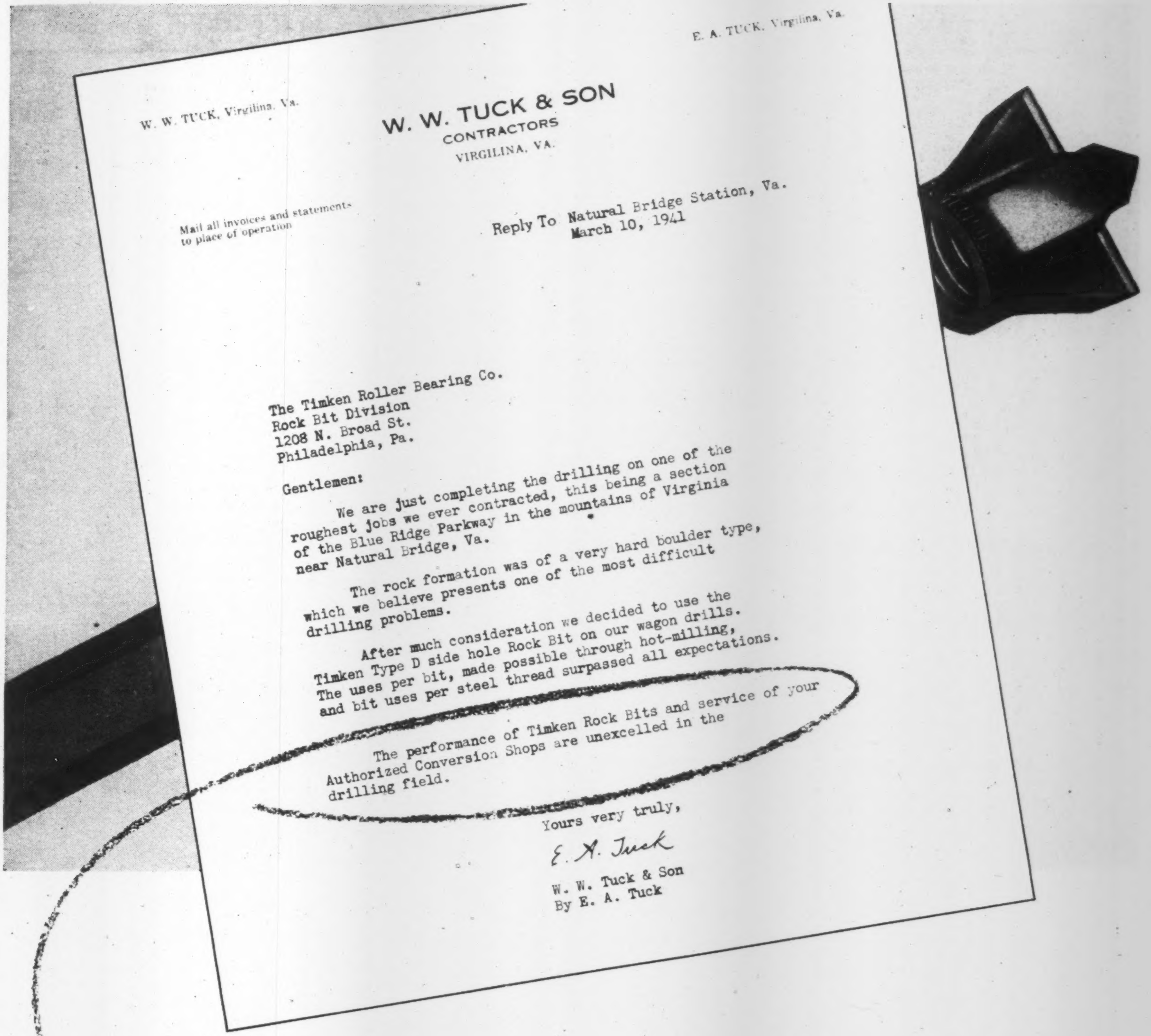
Prices f.o.b., per tie for carload lots:		6"x8"x8′ Untr.	 Tr.	7"x9"x8′6" Untr.	 Tr.
Boston	Oak	$1.20	....	$1.65	....
	Pine	1.50	$2.25*a*	2.25	$3.20*a*
New York	S. L. Sap Pine	1.20/1.30	1.95	1.60	2.55
	Mixed Oak	1.55	2.05	2.00	2.65
Birmingham	White Oak	.85	1.50*a*	1.35	1.70*a*
	Southern Pine	.55*b*	1.10*ab*	.70	1.30*a*
Chicago	Oak	....	1.65*a*	....	2.25*a*
	Southern Pine	....	1.53*a*	....	2.13*a*
Los Angeles	Douglas Fir	.64	1.38*a*	.90	1.80*a*
Philadelphia	Red Oak	1.10	....	....	2.40*a*
St. Louis	White Oak	1.30	....	1.65	....
	Red Oak	1.30	1.75*a*	1.65	2.25*a*
	Sap Pine or Cypress	1.20	....	1.55	....
San Francisco	Douglas Fir	1.00*bef*	....	....	2.45*caf*
Montreal	Birch or Maple	.65	1.05*a*	.75	1.35*a*

Tr.— Treated; Untr.— Untreated. *a* Creosoted. *b* 6" x 8" x 8′6". *c* Empty cell. *d* Zinc. *e* Green. *f* At ships tackle.

CHEMICALS

Water, sewage treatment, road work, f.o.b. carlots, New York

Bleaching powder, in drums, f.o.b. works, per 100-lb	$2.00–2.85
Chlorine cylinders, liquid, per lb. delivered	.0525
Calcium chloride, 77–80%, flaked, in 400-lb. drums or 100-lb. moisture proof bags, delivered, per ton	20.50–35.00
Silicate of soda, 52 deg., in drums, f.o.b. works, per 100 lb	1.40
Soda ash, 58%, in paper bags, per 100 lb. dense	1.10
Sulphate of aluminum, commercial, in 100-lb. bags, per ton	23.00
Sulphate of copper, in bbl., per 100-lb	4.75



W. W. TUCK, Virgilina, Va.

E. A. TUCK, Virgilina, Va.

W. W. TUCK & SON
CONTRACTORS
VIRGILINA, VA.

Mail all invoices and statements
to place of operation

Reply To Natural Bridge Station, Va.
March 10, 1941

The Timken Roller Bearing Co.
Rock Bit Division
1208 N. Broad St.
Philadelphia, Pa.

Gentlemen:

We are just completing the drilling on one of the roughest jobs we ever contracted, this being a section of the Blue Ridge Parkway in the mountains of Virginia near Natural Bridge, Va.

The rock formation was of a very hard boulder type, which we believe presents one of the most difficult drilling problems.

After much consideration we decided to use the Timken Type D side hole Rock Bit on our wagon drills. The uses per bit, made possible through hot-milling, and bit uses per steel thread surpassed all expectations.

The performance of Timken Rock Bits and service of your Authorized Conversion Shops are unexcelled in the drilling field.

Yours very truly,

E. A. Tuck

W. W. Tuck & Son
By E. A. Tuck

W. W. Tuck & Son, contractors, drilling on a section of Blue Ridge Parkway, Virginia. TIMKEN Bits used 100%.

This paragraph tells why contractors continue to use TIMKEN Bits and why TIMKEN Bits win new friends every day. Have you ever tried them?

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

TIMKEN
ROCK BITS

STRUCTURAL CLAY BUILDING TILE, BRICK AND LIME—DELIVERED

	STRUCTURAL CLAY TILE — PARTITION — SCORED Per M. lots of 2,000 pieces or over.			STRUCTURAL CLAY TILE — LOAD BEARING — SCORED Per M. lots of 2,000 pieces or over.			BRICK Per M. in quantity.		LIME		
	3x12x12 in.	4x12x12 in.	8x12x12 in.	8x12x12 in.	10x12x12 in.	12x12x12 in.	Common backing	Straight hard	Per ton, Hydrated finishing	In paper, Common hydrated	Carload lot, Pulverized or lump
Atlanta	$90.00	$100.00	$185.00	$220.00	$230.00	$240.00	$13.00	$18.00	$26.50	$17.00	$17.00
Baltimore	80.00	85.00	160.00	190.00	235.00	290.00	14.00k	17.00k	19.00	16.00	2.50m
Birmingham	80.00	85.00	160.00	191.00	252.00	285.00	14.00	17.00	18.11	12.64	1.66lo
Boston	98.70a	105.30a	206.85a	236.15	310.85a	346.00a	17.00i	20.00i	19.50	14.91	17.50l
Chicago	68.10	72.60	135.90	185.70	234.90	268.10	11.50	12.50	16.40	14.40	12.20
Cincinnati	61.40	65.30	121.90	141.50	187.30	215.20	16.00	16.00	15.40	13.00	......
Cleveland	56.50	60.00	112.50	135.00	182.00	209.00	16.00	16.00	15.00j	12.00j	2.75jm
Dallas	50.00	52.00	100.00	135.00	200.00	250.00	11.50i	13.50i	19.00	15.00	.95n
Denver	84.80	94.40	152.70	178.20	212.00	227.90	13.50	17.00	30.00j	19.00j	30.00j
Detroit	69.00	73.60	138.00	176.00	232.00	265.00e	16.50	17.00	16.50	13.90	14.90
Kansas City	64.50	66.50	86.00c	125.50	159.75	186.25	14.50	24.00	19.10	12.80	10.70
Los Angeles	73.50†r	89.50†r	128.00c†r	210.00†r	368.00†r	460.00†r	13.50	15.00	16.50	17.50	17.50
Minneapolis	71.45	76.20	143.95	171.45	173.80	242.10	13.10	15.10g	21.00	16.00	19.00
Montreal	72.20au	77.50au	142.50au	76.00atu	165.80au	248.70u	17.50†u	24.25†u	23.50u	17.00u	12.00u
New Orleans	72.00	72.00	135.00	162.00	210.00	260.00	14.00	......	18.30	12.08	14.10
New York	87.00	93.00	128.00c	193.30h	238.80h	295.60h	13.50	......	19.00	14.00	17.00
Philadelphia	80.50	85.90	161.10	193.30	238.80	295.60	17.00s	19.00s	15.70q	10.05q	12.05q
Pittsburgh	58.40	62.40	116.85	124.00	153.00	193.75	17.00	25.00	17.90	15.40	2.55m
St. Louis	62.00	88.00	120.00	180.00	234.00	280.00	16.00	17.00	22.00	16.00	2.30lm
San Francisco	84.00	94.50	225.00	......	......	......	14.00	17.00	.75o	2.05o	16.40
Seattle	100.00	110.00	220.00	......	......	......	18.00f	22.00f	20.00s	20.00s	20.00s

† F.o.b. a Smooth. b Carload lots delivered to job. c 6x12x12 in. d Not load bearing. e 48 lb. tile. f Less $1.00, ½ cash 15 days, balance 30 days. g Selected common. h F.o.b. Perth Amboy, N. J. i 50c. per M. off for cash. j LCL. k $1.00 discount if paid in 10 days. l Lump. m Per bbl., 180 lb n Per sack 100 lb. o Per bbl., 200 lb. p 280 lb. bag. q 25-ton cars. r 5% discount 10 days. s 2% off cash. t 5¼ x 8 x 12. u Plus 8% sales tax.

PAINT, ROOFING—F.O.B. CARLOAD LOTS

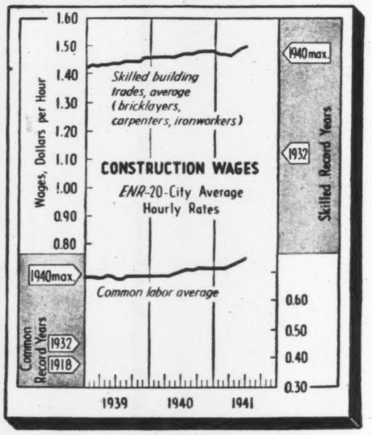
	RED LEAD Per 100 lb. in. 600-lb. (Approx.) bbl.	WHITE LEAD	READY-MIXED PAINT Per gal., drums			ROOFING SUPPLIES Carload lots f.o.b. factory				
	Dry a	Per 100 lb. in oil	Graphite b	Aluminum c	Ferric Oxide d	Rolls, slate surfaced, 85-90 lb. per sq.	Asphalt felt, per 100 lb.	Tar felt, per 100 lb.	Asphalt coating per gal.	Tar pitch 350 lb. bbl, per ton
Atlanta	$9.50	$13.625	$1.30	$2.25	$1.20	$1.90	$1.61	$1.61	$0.27	$29.00
Baltimore	9.25	13.25	1.80	2.75	2.25	2.60	3.25	3.25	.70	2.50m
Birmingham	9.50	13.625	2.35	2.75	1.85	1.98	1.57	1.57	.32	27.00
Boston	9.25	13.25	1.90‡	2.40‡	1.80‡	1.96‡	1.85h‡	1.85h‡	.50‡	20.00‡
Chicago	9.25	13.25	2.10	2.63	1.72	1.45hf	1.50hf	1.50hf	.26f	22.00f
Cincinnati	9.25	13.25	1.65	2.85	1.55	2.40	2.39h	2.39h	.36	21.00
Cleveland	9.25	13.25	2.10	2.80	1.60	1.66	1.42h	1.42h	.34	21.00
Dallas	9.25	14.00	1.88	2.11n	....	2.50h	2.60h	2.70h	.50	34.00
Denver	9.75	13.75	1.65	2.40	.17l	2.45	4.00	3.00	.35	28.00
Detroit	9.25	13.25	1.75	2.75	1.25	2.40	2.50	2.50	.35	26.00
Kansas City	9.25	13.275	2.15g	2.40g	1.67g	1.93	2.09	2.09	.25	25.00
Los Angeles	9.50	13.75	1.60	2.25	2.30	2.10	1.50	....	.45	.....
Minneapolis	9.25	13.375	....	....	....	1.75i	1.50hi	1.50hi	.29	21.00
Montreal p	9.25	9.00	2.40	2.97	2.51	2.64	1.85	1.86	.63	1.85k
New York	9.25	13.25	2.02	2.55	1.64	1.92	1.66h	1.66h	.23	24.00
Philadelphia	9.25	13.25	....	....	....	2.27e	1.94he	1.94he	.41e	22.00
Pittsburgh	9.25	13.25	1.05	1.95	.80	1.95	1.94h	1.94h	.34	26.00
St. Louis	9.25	13.25	1.90/2.00	2.60/2.80	1.60/2.00	1.65	1.50	1.50	.24	21.00
San Francisco	9.50	13.50	1.80	2.75n	1.10/2.00	1.65	2.26	2.26	.28	17.00
Seattle	9.50	13.75	1.80	2.60	....	1.67	1.18h	1.75	.35	28.00j

‡ Delivered. Note: Red lead in oil 50c. higher than white lead in oil a Red lead prices change frequently due to pig lead price changes. b U. S. War Dept. Spec. 3-49A. c ASTM Spec. D266-31. d 80% minimum ferric oxide. e Subject to 25% discount. f Distributors' price to contractors. g 5 gal. can. h Per roll, 65 lb. i Minneapolis and vicinity. j Asphalt pitch. k Per 100 lb. l Per lb. m Per bbl. n May price, no June quotation available. p Plus 8% sales tax.

SKILLED AND COMMON WAGE RATES—PER HOUR

	Bricklayers	Carpenters	Struct. Iron Workers	Hoisting Engineers	Plasterers	Common Labor Building	Common Labor Heavy Const.
Atlanta	$1.375	$1.00	$1.375	$1.00/1.25	$1.25	$0.40	$0.50
Baltimore	1.50	1.25	1.65	1.50	1.375	.625	.625
Birmingham	1.25/1.50	1.00/1.125	1.50	1.00/1.25	1.25	.40	.40
Boston	1.50	1.25	1.50	1.625	1.625	.60/.85	.60/.85
Chicago	1.70	1.625	1.70	1.70	1.70	1.025	1.025
Cincinnati	1.625	1.45	1.55	1.375/1.525	1.625	.75	.75
Cleveland	1.75	1.50	1.75	1.75	1.75	1.00	1.00
Dallas	1.50	1.00	1.25	1.00	1.50	.50/.625	.50/.625
Denver	1.65b	1.43b	1.43b	1.43b	1.50b	.718b	.718b
Detroit	1.60	1.40	1.75	1.625	1.675	.80	.80
Kansas City	1.625	1.375	1.50	1.50	1.575	.85	50
Los Angeles	1.375	1.10	1.375	1.375	1.50	.655	.655
Minneapolis	1.375	1.25d	1.50	1.40	1.50e	.90	.90
New Orleans	1.50	1.25	1.50	1.375	1.375	.55	.55
New York	2.00b	1.85b	2.00	2.00b	2.00c	1.031	.95
Philadelphia	1.65b	1.40	1.65	1.50	1.75	.70	.70
Pittsburgh	1.75	1.50	1.50	1.25	1.75	.80	.70
St. Louis	1.25/1.50	1.00/1.50	1.75	1.50/2.00	1.25/1.75	.675/.875	.875
San Francisco	1.75c	1.25	1.60	1.50	1.667c	.85/.875	.85/.875
Seattle	1.65	1.35	1.55	1.50	1.65	.95	1.00
Montreal	.80	.70	.75	.65	.80	.45	.40

b 7 hr. day. c 6 hr. day d 35 hr. wk. e 30 hr. wk.



ENR Skilled Average: (Bricklayers, Carpenters, Ironworkers) $1.492
ENR Common Average: $0.747